Observed changes in coyote behavior indicating

an increasing risk to human safety[1]:

Behavioral Score Codes

0) Normal or typical coyote behaviors that indicates coyotes may be avoiding humans.

1) An increase in observing coyotes on streets and in yards at night

2) An increase in observing coyotes approaching adults and/or taking pets at night in yards or in the presence of humans.

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 from residential streets or yards.

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.

[1] TIMM, R.M., R.O. BAKER, J.R. BENNETT, AND C.C. COOLAHAN. 2004. Coyote attacks: An increasing suburban problem. Transactions North American Wildlife and Natural Resources Conference 69:67-88.

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MANAGEMENT OF CONFLICTS BETWEEN URBAN COYOTES AND HUMANS IN SOUTHERN CALIFORNIA

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MANAGEMENT OF CONFLICTS BETWEEN URBAN COYOTES AND HUMANS IN SOUTHERN CALIFORNIA

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ABSTRACT: An apparent increase in coyote-human conflicts, notably attacks on humans, demonstrates that such incidents are not rare in California. The authors discuss coyote attacks on 53 humans, resulting in 21 instances of human injury, over the last decade. These illustrate repeated, predictable pre-attack coyote behavior patterns. Specific changes in human environments and in human behavior that have contributed to coyote attacks are discussed. Case histories of attacks reveal contributing factors and suggest appropriate corrective and preventive actions. Padded leghold traps have been the most effective and efficient tool in removing problem coyotes and changing the behavior of coyotes to fear humans and the urban environment. Long-term solutions will require changes in human behavior. Humans must come to view large mammalian predators as a potential hazard. Increased public education is needed to improve methods of landscape management, refuse disposal, care of pets, and recognition of the need for predator management.

KEY WORDS: coyote, urban coyote, coyote-human attacks, coyote behavior, human safety

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INTRODUCTION

Prior to 1981, coyote (*Canis latrans*) attacks on humans were thought to be rare, although coyotes frequently interact with humans throughout much of North America (Carbyn 1989; Young and Jackson 1951). Howell (1982) reported the tragic death in 1981 of a 3-year-old girl in Glendale, California resulting from a coyote attack. He also documented eight other cases in Los Angeles County, over a seven year period (1975 to 1981), of people being attacked. Carbyn (1989) summarized information from warden and park ranger reports from Banff and Jasper National Parks, Canada, and Yellowstone National Park, Wyoming, which involved 20 coyote attacks on humans over a 28-year period (1960 to 1988). Fourteen of the attacks resulted injuries; four cases involved serious injuries to small children.

Connolly (1992) noted that 56 coyote-related human health and safety incidents nationally were reported to USDA-APHIS-Animal Damage Control offices during fiscal year 1990. These were in addition to reports of coyote predation on pets, as well as on livestock and poultry. He noted that coyote attacks on humans are "an unusual but significant aspect of coyote- management in modem society." The diversity of damage situations noted in Connolly's paper reflects the coyote's adaptive abilities as related to modem human society.

The number of coyote attacks on pets reported annually to USDA Animal Damage Control (ADC, now "Wildlife Services") in California has risen steadily, from 36 incidents in 1991 to 394 in 1996 (John E. Steuber, pers. comm.). Many other cases were reported to veterinarians and animal regulation organizations in counties not served by ADC. Attacks on pets, especially as they relate to human safety and coyote behavior will be discussed. In many instances, they may be a predictive precursor to more serious coyote-human conflicts.

Coyote attacks on humans are no longer rare or unusual in many California urban fringe areas. Developed sites such as parks, residences, commercial centers, and trails used for recreation and exercise, in or near wildland areas, are all susceptible to coyote-human conflicts. Over the last decade there has been an alarming increase in the number of reported coyote attacks on children, adults, and pets in California. Howell (pers. comm. 1982), Walter E. Howard (pers. comm. 1981 and 1998), and Carbyn (1989) believe that, in these instances, coyotes have lost their fear of humans and have regarded the children as prey.

In this paper, coyote attacks on 53 people in 16 locations, resulting in 21 bites, is documented and described. In addition to those bitten, coyotes harassed more than 32 individuals over a 10-year period. Case studies of the verified coyote attacks on humans, discussed in the text below and summarized in Table l, provide details surrounding the circumstances of each incident. The authors review changes in the environment, social values, and human behavior in California that have contributed to this problem. They describe the methods utilized in solving these conflicts, and provide recommendations on ways to prevent future coyote attacks on humans.

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

Table 1. Verified Coyote Attacks, August 1988 to September 1997.

Location	Date	Victim	Attack Details
Oceanside	08/88	8-year-old Girl	Approached by coyote while rollerskating, after she had fallen. Coyote tugged at her skate and was scared off by two women who threw rocks. (Morning)
Oceanside	08/88	4-year-old Boy	Nipped and bruised by coyote, while playing in yard. (Morning)
Oceanside	08/88	3-year-old Girl	Coyote grabbed child by the leg and pulled her down, then bit her on head and neck. Coyote chased off by mother and neighbors. (Early evening, 7 p.m.)
San Diego	10/88	Adult Female	Bitten by coyote in backyard, while talking on phone. (Daytime)
Madera County (Reds Meadow)	06/90	5-year-old Girl	Attacked and bitten in head while in sleeping bag at campground. (Night, 3 a.m.)
Madera County (Reds Meadow)	06/90	2 Persons	One person bitten on foot through sleeping bag; one bitten on hand. At same campground as above.
Laguna Niguel	09/91	Adult Male	Man chased, and his poodle was ripped from his arms; the dog was taken by the coyote.
San Clemente	05/92	5-year-old Girl	The girl was attacked, and climbed a swing set to get away; she was bitten several times on her back. Mother chased off the coyote. (Daytime)
Newport Beach	07/94	2-year-old Boy	Coyote stalking boy. Child did not move before mother rescued child, when the coyote was five feet away, crouched for attack. Coyote remained while mother shouted and backed into home. Coyote eventually left. (Daytime)
Griffith Park	10/94	Adult Male	Man with no shirt or shoes bit by coyote. (5 p.m.)
Griffith Park	03/95	Adult Male	Man with no shirt bit by coyote. (12 noon)
Griffith Park	03/95	5-year-old Girl	Coyote stalked and then knocked down child twice, as reported by witness. Mother rescued child and left. (Daytime)
Griffith Park	06/95	Adult Female	Woman in shorts, no shoes, preparing food, bit by coyote. (Daytime)
Griffith Park	07/95	Adult Male	Man bitten by coyote while sleeping on lawn. (Daytime, 2:45 p.m.)
Griffith Park	07/95	Adult Male	Man bitten by coyote while sleeping on lawn. (Daytime, 4 p.m.)
Griffith Park	07/95	15-month-old Girl	Coyote was chased away once, then returned to attack infant in jumpsuit; child suffered bites to leg. (Daytime, 4 p.m.)
Laguna Nigel	06/95	6 Adults and Children	All were chased from patio table by coyote. Chicken dinners taken and eaten, despite yells of adults in an attempt to scare the coyote.
Laguna Nigel	06/95	Adult Male	Man attacked while lying on chaise lounge, stargazing. Bitten on bare foot. (Night)
Laguna Nigel	06/95	Adult Male	Bitten on bare foot while getting paper from front yard. (Mid-morning)

Table 1. Continued

Location	Date	Victim	Attack Details
U.C. Riverside	06/95	7-year-old Boy	Victim bitten as three boys were chased. (Late afternoon)
U.C. Riverside	06/95-11/95	Several Adults	Joggers were chased. (Late afternoon)
U.C. Riverside	11/95	3-year-old Boy	Children chased while playing, and one bitten. (Late afternoon)
San Juan Capistrano	01/97	2 Adult Females	Attacked and one woman bitten twice on left ankle and pulled to ground. Both yelled, used alarm device, and swung handbag. Had no food.
San Juan Capistrano	01/97	Adult Female	Coyote assaulted employee, grabbed lunch pail, and ran.
San Juan Capistrano	01/97	Adult Female	Coyote charged employee, took purse containing lunch and personal belongings.
San Juan Capistrano	01/97	Adult Female	Coyote stalked employee but was frightened off by other workers.
San Juan Capistrano	01/97	3 Adult Females	Aggressive coyote charged 3 employees; was frightened off by van driver honking horn.
San Juan Capistrano	01/97	Adult Female	Coyote charged employee, attacked, and took purse.
San Juan Capistrano	01/97	Adult Male	Coyote attacked man, bit shoe, no injury. Coyote refused to retreat. (Before daylight)
San Juan Capistrano	01/97	Adult Male	Coyote jumped on back of employee, biting his backpack. Was knocked off and retreated.
South Lake Tahoe	02/97	Adult. Male	Man attacked and bitten on hand while feeding coyote. (Late morning)
South Lake Tahoe	02/97	4-year-old Girl	Child in yard attacked from rear and severely injured on face. Heavy snowsuit protected all but face. Father rescued child. Coyote stayed in unfenced yard and was shot by police. (Late morning)
San Clemente	03/97	2-year-old Girl	Child was stalked, but was saved by father when coyote was in freeze mode, 4 feet away, prior to attack. Father needed help of second man, as yelling had not deterred coyote. Coyote slowly left area with much hesitation after being hit with stick. (Late morning) Coyote returned on several days after until trapped.
Pomona	09/97	Adult Male	Man was stalked, then attacked by two coyotes, and bitten on ankle. (Early evening-, in daylight)

COYOTE-HUMAN CONFLICTS 1988 TO 1997: CASE HISTORIES

Most of the coyote cases occurring between 1991 and 1997 are ones in which the senior author (R. O. Baker) was personally involved as a consulting wildlife biologist for Animal Pest Management Services (APM) of Chino, California. Other cases were brought to the authors' attention by news articles, calls from California Department of Fish and Game, information reported to the USDA-APHIS-ADC (WS) program, or calls received California State Polytechnic University-Pomona (Cal Poly). The senior author is a professor and researcher on wildlife, public health, and integrated pest management issues at this University, and his visibility draws many public information inquires. Additional cases have been brought to light by a survey initiated by the senior author through the Wildlife -and Vertebrate Conflicts Project at Cal Poly-Pomona. The junior author (R. M. Timm) researched circumstances surrounding the bite incidents that occurred in 1988 and 1990. The cases reviewed here are from southern California, except for two from South Lake Tahoe that seem to have the same type of causal relationships.

From the authors' perspective, coyote activity complaints escalated in the summer of 1941, with the senior author receiving more than a dozen calls from citizens in Anaheim Hills, Orange, Laguna Niguel, San Clemente, and San Juan Capistrano. The complaints involved three cases of horseback riders whose horses were being chased or nipped in the Orange area of the Santa Ana River trails system. Two dogs were attacked while on a leash in the same Santa Ana River area; one of the two dogs was killed, the other injured, and the adult owners were traumatized but not bitten. One dog owner in Anaheim Hills saved a poodle from being taken over her yard's rear wall. The dog had been let out of the house for a comfort break; it was grabbed, by a coyote, from the patio next to a sliding glass door where adults were sitting inside. The coyote returned daily about the same time until it was trapped. Most of the other calls involved coyotes in parks, in front and rear yards of residences where children played, or were calls from owners who had lost gets to coyotes. All totaled, seven adults reported being approached or harassed by coyotes.

All coyote-human conflict cases in progress that came to the attention of the senior author were first evaluated by phone to determine the severity of the problems. It was the desire of the authors to find out what the callers had done themselves or could do to resolve the problem. Many people who lost pets were advised on what they could do to prevent future problems, and they were often referred to kennel or fence companies and to a local animal regulation agency. Before any population dispersal or reduction program was initiated, a thorough site evaluation was performed. This evaluation involved looking for signs of all animal species in the area, and for human activity that might affect the project. Further, human attitudes of the client and the community were examined, and the need for public education was evaluated. Alternative measures, rather than coyote population reduction, were usually initiated unless a human had been attacked. In instances of attacks on humans, some type of population reduction and/or behavioral modification was promptly implemented.

These cases demonstrate the manner in which human-caused changes in the environment, coupled with changes in human behavior toward coyotes, may result in the development of serious human-coyote conflicts. Public awareness of the danger of coyotes and other large predators to humans and pets was found to remain a limited and localized issue, primarily existing where prior problems had occurred. The general public's lack of concern and awareness is a serious problem and is the real root of coyote-human conflicts.

Information on human attacks by coyotes from August 188 to September 1997 that have been personally verified by the authors are listed in Table 1. These cases are discussed roughly in chronological order of their occurrence. Observations of common pre-attack coyote behavior that may be predictive of subsequent attacks on humans are included. The methods used to successfully resolve the problems are described.

Oceanside, San Diego County, 1988

Three children were approached or bitten in separate events an August 16, 17, and 18, 1988 in the Oceano, Hermosa, and Peacock Hills area of Oceanside. In the three weeks prior to these events, USDA-ADC personnel had received 30 to 40 complaints of coyotes attacking or killing household pets, or approaching people during daylight hours in the Oceanside area. During approximately the same time period, the commanding Brigadier General of the adjacent Camp Pendleton Marine Base had reported that coyotes harassed his wife and threatened the family's dog.

In one incident, when an 8-year-old girl fell while roller-skating, a coyote ran at her and grabbed her skate. Two women chased the animal away by throwing rocks at it. In a second incident, a 4-year-old boy playing in front of his grandfather's home was nipped in the knee by a coyote, causing a bruise. In. a third incident, 3-year-old Jessica Lee, while playing in her grandfather's driveway, was grabbed on the leg by a coyote that pulled her down, biting her on the leg, neck, and head. Her mother and neighbors screamed at the coyote and chased it away. During the week following the three incidents involving children, an ADC Specialist removed three coyotes from the area, two by use of leghold traps and one by shooting. One of the trapped coyotes ˙was found to be suffering from distemper. No further coyote attacks on humans were reported.

San Diego, San Diego County, 1988

A 24-year-old woman was approached and bitten by a coyote in an urban area of San Diego, while talking on a cellular phone in her backyard. Neighbors in the area reported recent sightings of coyotes boldly wandering in the area. A resident two houses away had lost a small dog to a coyote, and three or four cats in the neighborhood had similarly been taken. The ADC Specialist who responded to the complaint removed the offending coyote within less than a week by use of a leghold trap in the woman's yard. No further incidents were reported.

Reds Mountain Campground, Madera County, 1990

A 5-year-old girl in a sleeping bag was attacked and bitten during the early morning of June 29, 1990. The campground is about six miles west of Mammoth Lakes in the Inyo National Forest. Adults sleeping near the child, awakened by the child's screams, saw the coyote retreat. The child sustained a severe scalp laceration and several canine puncture wounds, and she received medical treatment. USDA-ADC personnel and others, working in cooperation with U.S. Forest Service and Park Service personnel, shot four coyotes in the vicinity. Interviews with park rangers and campground residents revealed that people in the area had been feeding coyotes. It was also noted that skiers at Mammoth Mountain, only a few miles away, had been feeding coyotes during the winter ski season. Observers noted that the coyotes would readily approach people for food, showing little fear. The investigation also revealed two previous biting incidents had occurred the same day. One person was bitten on the foot through a sleeping bag, while another individual was bitten on the hand; no other details of these incidents were documented in the records at California's USDA-Wildlife Services office. Forest Service and Park Service officials quickly instituted an educational program to stop

visitors from feeding coyotes or other wildlife, or leaving food available. A Park Service official noted that the shooting effort immediately instituted a fear of humans in the remaining coyote population.

Laguna Nigel, Orange County, 1991

This case involved a pet owner who had his poodle taken out of his arms by an attacking coyote. The poodle was not saved. Coyotes had been seen in early and late mornings chasing and killing cats and rabbits in the neighborhood prior to this attack. After this incident, several coyotes were taken with padded leghold traps and euthanized, and there has been no re-occurrence of problems at this site (the 1995 incidents in Laguna Nigel were in a different neighborhood and are considered unrelated).

San Clemente, Orange County, 1992

The attack on a child was preceded by three to four weeks of coyote attacks on two dogs and six house cats, as reported to San Clemente Animal Control (Gene Begnell, San Clemente City Fire Department/Animal Regulation, pers. comm.). All of the attacks were in the same residential area, and coyotes were readily seen day and night, especially on trash collection days. One licensed childcare facility reported having to bring children inside from the rear yard, which faced a common landscaped slope, due to a coyote stalking the children's play area (Figure 1). This facility was about one-quarter mile from the nearest wildlife fringe area. The 5-year-old girl who was bitten attempted to escape from the coyote by climbing onto a swing set. The child's mother scared off the coyote, but the girl sustained several bites on her back. Police tried to shoot coyotes for several nights after the child was attacked, but they failed to take any coyotes. Two coyote dens and numerous bedding areas were found in the landscaped slope areas throughout the development. Trapping was conducted for 10 days by APM, resulting in removal of six coyotes, primarily adults. Another two coyotes were shot by APM biologists. Coyotes have not been a problem since the control program. When seen, they are now on outer fringe areas and run to avoid humans.

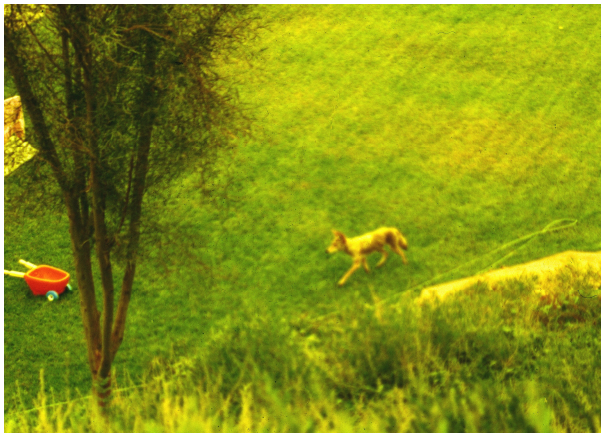

Figure 1. Coyotes frequented an area near a childcare facility, San Clemente, 1992.

Newport Beach, Orange County, 1994

Neighborhood attacks on domestic animals and pets over a six-month period preceded the July 1994 incident where a mother rescued her 2-year-old child that was being stalked by a coyote. Neighbors near Upper Newport Bay reported seeing coyotes, with no apparent fear of humans, foraging in neighborhoods and yards during daylight hours. The mother screamed and ran out of the house to rescue her toddler, after looking through a window into the backyard and seeing a coyote apparently crouched for attack, five feet away from her son. She had lost 23 chickens and 22 rabbits to coyotes in her backyard during the preceding months, and a neighbor's German shepherd had been killed by coyotes. City animal control authorities recommended residents take steps to remove coyote food sources, and they initiated an effort to shoot the offending coyotes.

Griffith Park, Los Angeles County, 1994 to 1995

These attacks began about four months after coyotes started to be seen making late morning and afternoon visits to turf and picnic areas. These early signs are consistent with numerous reports of increased activity in early summer when adult coyotes typically are hunting for their fast-growing pups. Reports of cats and rabbits being chased and eaten by coyotes on turf areas became common, as did the finding of remains of cats, skunks, and rabbits. About two months before the first human attack, picnic patrons began reporting coyotes begging for food, followed by reports of coyotes scaring people away from their picnic provisions. Five adults were subsequently attacked and bitten by coyotes in the park. Then, a 15-month-old child was bitten through a heavy jump suit and was rescued by the child's mother as the coyote attempted to carry the child away. The mother had previously chased the coyote away 10 to 15 minutes before the attack.

All of the attacks occurred within 100 yards of heavy brush habitat, usually on lawn areas. Only two of the attacks appear motivated by hunger-the smallest child that the coyote tried to run off with, and the June 1995 attack on the woman who was preparing food. Most of the other victims were men sleeping on various lawn areas, some as close as 10 to 12 yards from brush, but most were from 25 to 150 yards from brush. All the attacks occurred between noon and 5:00 p.m., and resulted in bites to the feet or legs. As noted on the Park Incident Reports, most of the attack victims had bare feet, a possible contributing factor that warrants further study.

Site evaluation and ranger interviews identified two primary activity areas. It appeared likely that two coyote family groups were causing the problems. Tracks indicated three to four sizes of coyotes were active in each area. Dense brush covered the canyons and hills in these areas. Mountain shrub and brush areas adjacent to attack sites were searched for dens, to determine if the attacks were associated with protective territorial behavior in the March to July incidents. However, all dens found were located more than 200 yards from the attack areas, and numerous well-used hiking trails were much closer than the attack areas. Many coyote trails and bedding areas were found; they were littered with chicken bones, food wrappers, and skunk, rabbit, and cat remains.

Safety warnings were posted and passed out to park visitors, requesting them to report coyote sightings, informing them to keep children close, and not to feed coyotes. Because many open and overflowing trash containers had been observed during the site evaluation, sanitation practices were initiated as recommended.

Since the coyotes' behavior represented an immediate danger to park visitors, a special team of APM wildlife biologist sharpshooters was brought in for several nights, after park closing, to focus on the target areas and problem coyotes only. Five older adult and three young adult coyotes were removed. The coyotes were called into safe shooting zones by use of recorded urban animal and baby-like sounds. The dominant adults were quick to react. Cage traps and cannon nets were also used. One juvenile coyote was cage-trapped using a chicken as bait in the trap. Coyote capture success is rare with cage traps, but the City of Los Angeles would not allow use of padded leghold traps. Since removal of these two family groups, there have been no further problems. Only one very wary coyote has been seen in the problem areas, even though there are many coyotes actively using the wildland areas of the park.

Laguna Nigel, Orange County, 1995

These problems started after coyotes were observed for several months on streets and in yards, in daylight and evening hours, and followed numerous attacks on pets. Coyotes fed out of get dishes; and they commonly roamed the streets on trash collection day. After the two human bite case, seven coyotes were removed by trapping. There have been no subsequent reports of human attacks or harassment. Occasional sightings of coyotes have been made at night recently, but they are still very wary of humans. Of interest was the location of the bite cases which, unlike all but the UC Riverside cases (below), occurred several blocks from canyons or native brush.

UC Riverside, Riverside Count, 1995

On the campus of the University of California-Riverside (UCR), cat remains were found numerous times during the two to three months prior to the first attack on children. It was discovered that residents of the campus family housing area had been leaving feed out for feral cats. Coyotes were seen chasing and carrying off cats at night and early in the morning. By late spring coyotes were observed feeding on cat food in the afternoon, and they were occasionally reported to chase joggers on rural trails. In June, three boys in the housing area were chased out of a playground by a coyote that eventually caught and bit a 7-year-old boy. Between the first attack at UCR (June 1995) and the second one (November 1995), adults accompanied the children to the playground, and most children stayed closer to home. Coyote activity increased during daylight hours on and near the campus. A coyote even appeared on a soccer field during a game attended by numerous fans. More joggers and cyclists reported being chased near a heavily landscaped area.

After the second child was attacked, a site evaluation revealed pet food left out for one or two remaining cats, and areas of exposed garbage and trash were identified. Numerous rabbit remains were seen around several shrub and lawn areas, and coyote feces were found to contain rabbit, skunk, roof rat; fruit, trash, and cat or dog food. Of necessity, shooting was restricted to a very limited area that was deemed a safe shooting zone, and which was out of public sight. Recorded urban animal cries, as well as the call of a distressed cottontail, were again used to attract the coyotes. Only two adult coyotes were taken using firearms. Leghold traps were successfully used to remove an additional five coyotes. Now, over two years later, no more attacks or harassment have occurred, even though feral cats have started to populate the campus again. No coyotes have been spotted on campus in daylight hours, but occasionally one is seen at a distance at night in the native plant garden area and in adjacent brush on the east side of campus. Some of the trapped coyotes came from the freeway right-of-way, and others traveled on the railroad right-of-way from wildland habitat about one-quarter mile (0.4 km) to the east.

San Juan Capistrano, Orange County, 1997

The Nichols Corning Institute, a large facility employing about 1,000 people, is located on 100 acres in a rural area about 10 miles from a densely populated development in San Juan Capistrano. When developed, the landscaping was designed to maintain as many native plants as possible, including dense chaparral and coastal sagescrub located about 20 yards from the buildings. A large pond with a sizeable adjacent lawn area was also established. Employees frequently ate on the lawn area and in their cars in the parking area, as well as on the patio and in an indoor lunch and break area. Coyotes were often seen in adjacent wildland areas or running from the lawn and pond areas to the sagescrub area as cars approached. They were increasingly visible for about a two-year period, and by spring 1996 they had become noticeably bolder. By late summer, coyotes were frequently seen in daylight hours as well as late evenings around the parking lot and landscaped areas. Occasionally, they were seen chasing rabbits, raccoons, and skunks. They began approaching employees who were eating lunch on the lawns or walking to their cars.

In early December, management became aware of the unusual coyote behavior and distributed a letter warning employees of the possible danger coyotes posed as a result of their loss of fear of people. The letter suggested methods of possibly changing the coyotes' behavior by not bringing food outside of the buildings, and by not putting discarded food in outside refuse containers. If the coyotes approached employees, they were to stop and yell at them to scare them away. The letter encouraged employees to report coyote sightings to security personnel, so that they could chase or harass them. Management wanted to alter the coyotes' behavior without harming them, if possible.

Unfortunately, these actions were too late, as the coyotes became bolder, even approaching the patio when it was full of people at noon, sending them all back into the buildings. The security guards and shuttle drivers picked up the pace of harassing coyotes whenever they were seen. However, as listed in Table l, the first very aggressive attack occurred in January 1997. Two adult female employees were victims, one of whom was pulled to the ground by a coyote that bit her ankle twice. The two women yelled, hit the coyote with handbags, and

finally escaped the attack by getting into a car. Within two weeks, nine employees had been attacked on sidewalks and in the employee parking lot.

A site evaluation and recommendation was done by APM on January 13, 1997. Selective shooting was recommended, due to the severity of the case, and because heavy rain at that time made trapping less feasible. Management was apprehensive of possible bad publicity from shooting, so they opted to delay until drier soil conditions would allow trapping to be initiated. Meanwhile, Orange County Animal Control had responded to the site several times between January 5 and January 16 but had failed to capture any coyotes. After the January 17 attack, shooting was initiated despite inclement weather, and two adult coyotes were taken. Two more people, both adult males, were attacked the following week, and shooting was again initiated when weather permitted. Three additional coyotes were taken in one night.

In this series of attacks, most victims had purses or backpacks that the coyotes may have associated with food, even though there was little or no food in the purses taken. The lunch pail one woman used in an attempt to defend herself was empty. Because no further sightings on the grounds occurred, nor was coyote sign seen on trails, subsequent trapping was not initiated. Coyotes have not been seen on the grounds since the three were removed by shooting, but they are often seen on adjacent roads and hills. The habitat was modified as recommended, with all refuse containers being removed from the parking lot and other outlying areas. Brush near the areas of human activity was thinned. If coyotes begin to prey on rabbits again, a rabbit exclusion fence may be erected. The senior author presented a wildlife training class to the employees, and the Institute prepared a wildlife information handout for its staff.

South Lake Tahoe, El Dorado County, 1997

These incidents are included because the events and observations that preceded the attacks were similar to the southern California cases. In February 1997, late morning coyote activity had been reported at a ski lodge parking lot and in nearby neighborhoods. A man was bitten while actually feeding a coyote in the parking lot of a ski lodge. A 4-year-old girl, Lauren Bridges (Figure 2), was attacked in the yard of a South Lake Tahoe residence where she was staying with her family. She was largely protected by the heavy snowsuit she was wearing, but she suffered multiple wounds to her face. Sixteen of the wounds required stitches. The coyote had to be pulled off the child by the father, and it would still not leave after being hit. It appeared to stay "locked on" its prey until it was shot by a sheriff. Coyotes had been fed by a homeowner within a short distance of the site of the attack.

San Clemente, Orange County, 1997

The attack did not result in an injury because the parents, who have been prevented from putting up a coyote-proof fence by their homeowners association, only let the 2-year-old child play outdoors when they were with her. The coyote boldly approached the child, who was with her father and another man working on a backyard deck. It was seen a few feet away in a "freeze mode," seemingly locked onto the child as a prey item, and crouched for attack when the father grabbed the child. Had the child moved, the coyote most likely would have attacked, since movement is a key stimulus for initiating attack (Lehner 1976).

Trapping was initiated by APM, and several coyotes were removed by use of traps in the same yard (Figure 3). A compost pile and vegetable garden in the yard were used by the coyotes as food sources. Most feces collected in the area had a high occurrence of seeds of *Ficus nitida*, a street tree that produces a mass of berry-sized fruit. In addition to plant material, fragments of house cat, cottontail rabbit, small rodents, and pet food were found in coyote scats.

Figure 2. Four-year-old Lauren Bridges suffered multiple wounds to her face when attacked by a coyote in South Lake Tahoe.

Figure 3. A coyote continued to visit the backyard of a San Clemente residence on a daily basis after it had stalked a 2-year-old child.

Pomona, Los Angeles County, 1997

The adult male attacked by coyotes on the Cal Poly-Pomona campus was on a walkway in a native plant area between buildings. He was carrying a small uncut watermelon. When he saw the two coyotes nearby, he began to run and then was attacked (Kimberley Platter, Chief, Public Safety, pers. comm.). He was bitten on the ankle but did not require treatment, even though he fell on some steps in his attempt to escape.

The number of confirmed human and get attacks for the timeframe covered by this paper will undoubtedly increase as additional past incidents are brought to light. Additional incidents are also likely to occur during 1998. The senior author has initiated a survey on this subject, which is slated for completion in late 1998. Reports have been received, but not included here, of numerous other incidents of pets being torn out of owners' arms, cyclists being knocked over and/or chased, and joggers being nipped at by coyotes. The authors have included only reports that are documented by more than one reputable source, and preferably by a city, county, or state agency, or for which they have personal knowledge. Numerous animal regulation organizations and city authorities have 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 (Hector Hernandez, Director of Park Rangers, City of Los Angeles, pers. comm.).

THE CHANGING ENVIRONMENT

Howell (1982) described development of urban sprawl into southern California mountain ranges, providing miles of urban interface with native brushy habitats. Many of the natural open space areas scattered throughout southern California are canyons that serve as seasonal drainage areas. Some of these canyons extend from the mountain ranges to the ocean, or to major riverbeds and flood channels.

Wildland areas of heavy brush (chaparral and mountain scrub) on the suburban edge commonly support wild mammal populations limited to deer mice (*Peromyscus* spp.), woodrats (*Neotoma* spp.), and a few other small rodent species. These areas are not particularly good habitat for the cottontail rabbit, pocket gopher, ground squirrel, or meadow vole. By comparison, landscaped urban and suburban areas with open, plush plantings of gazania, clovers, legumes, grasses, or various popular ground covers provide a luxuriant habitat for small mammals.

Urban and suburban landscapes used to take approximately 18 to 20 years to mature before commensal rats (*Rattus norvegicus* and *R. rattus*) had enough vegetative cover to become a problem. Now, driven by new landscaping ordinance requirements, increased affluence, and less patience, people create, in as few as five to six years, landscapes that are more attractive to commensal rodents and other wildlife than are native areas (Baker 1984). Community plans and government ordinances, for aesthetic and noise abatement purposes, have changed freeways and streets into beautiful, heavily landscaped areas. Many such areas become heavily infested with rabbits (*Sylvilagus* spp.), pocket gophers (*Thomomys bottae*), ground squirrels (*Spermophilus beecheyi*), and meadow mice (*Microtus* spp.) within one to two years after planting. All of these mammals are found in the coyote's native diet. Thus, these modified areas serve not only as wildlife corridors between wildlands and area of human habitation, but they are sufficiently rich in food, water, and cover to become permanent habitat for coyotes. Coyotes, then, are drawn into suburbia by rich, relatively stable food sources. Loven (1995) has documented similar utilization of resource-rich urban and suburban areas by coyotes in Texas, resulting in attacks on pets.

Other indications of the habitat richness the wildland-suburban interface provides to coyotes are home range size and density. Coyote home range size is a factor of the density of basic resources: food, water, safe harborage, and social needs. Howell (1982) described the suburban coyote's environment as follows: "He is virtually unopposed and supplied with a substantial food base." Home ranges of coyotes in the wild have been found to be 12.6 to 25 mi^2 (21 to 41.6 km^2) for males and 4.8 to 6.0 mi^2 (8 to 10 km^2) for females (Chesness and Bremicker 1974; Gipson and Sealander 1972). Shargo (1988) found the home range of coyotes in suburban Malibu to be from slightly under 0.5 mi^2 to nearly 1 mi^2 (0.64 to 1.44 km^2) and the 24-hour range of movement to be an average of 3.48 mi (5.8 km). These significantly smaller home ranges indicate that coyotes have found the urban environment to have plentiful food, water, and safe harborage.

In regard to density, Knowlton (1972) suggests that 0.5 to 1.0 coyotes/mi^2 (0.2 to 0.4/km^2) is a good estimate for large wildland ranges. Others agree with Knowlton and give educated guesses of up to 5/mi^2 (2/km^2) for the best habitat. While good measures of coyote density in suburban southern California are not available, it may be inferred from the small home ranges seen by Shargo (1988) that coyote density is considerably higher here than in most other habitats. In the Glendale area, 55 coyotes were taken during control operations within one-half mile of the site where a coyote killed a 3-year-old girl, over an 80-day period in 1981 (Howell. 1982). Obviously, immigration of individuals into vacant home ranges was occurring, but this is another indication of the ability of this type of habitat to support high coyote densities. The authors suspect that human alterations of the environment on the wildland-suburban interface can create 10 to 20 times the natural carrying capacity for coyotes, as compared to undeveloped sites. The urban fringe areas, which apparently provide the best coyote habitat, have become the location for most coyote-human conflicts. However, not all urban or suburban areas provide such desirable habitat. Few mid-city areas offer good habitat unless they contain large parks or other habitat islands.

URBAN COYOTE BIOLOGY, DIET, AND BEHAVIOR

Coyotes, which resemble small German shepherd dogs, vary in size and weight according to subspecies and locality (Bekoff 1977; Gier 1968), with individuals from northern or higher-elevation areas tending to be larger. The average weight of coyotes removed from the Glendale area of southern California in 1981 was found to be 27.9 lbs. (12.7 kg) for males and 19.9 lbs. (9 kg) for females (Wirtz et al. 1982). Twenty-five adult coyotes removed recently from several Orange County projects by Animal Pest Management of Chino, California ranged from 21 to 45 lbs. (9.5 to 20.5 kg). These coyotes from urban area problem sites were often heavy-appearing, had healthy coats except for two with mange, and seemed to be in good health. These weights are similar to the ranges reported for other coyotes in the western U.S. (Wade 1983).

Most of the wildland coyote's activity occurs at night and early morning hours, especially in the warmer part of the year. On colder winter days, coyotes may hunt throughout the day depending on food availability and the presence of humans. Coyotes in urban areas have been observed by the senior author, and by a number of persons interviewed, to actively feed in late mornings and afternoons. They find food items on streets (refuse, and fruit of street trees), in yards of residences (fruit, rodents, pets, and pet food), on golf courses (rabbits. and ground squirrels) and in parks (pocket gophers, rabbits, meadow mice, roof rats, and food and garbage from picnickers). Many residents report coyotes habitually foraging for food every "trash day" (the day of the week that refuse containers are placed at the curb for collection) both at night and in early and late mornings. As Howell wrote, it was not unusual for early morning joggers and commuters to see one or more coyotes daily. Now, it is not unusual to see coyotes throughout the day in back yards, streets, parks and golf courses (Figure 4). In fact, many of the attacks described here have occurred in full daylight between 9:00 a.m. and 4:00 p.m. Most of the attacks have occurred within a few blocks of the urban fringe area where native brush is abundant or where open space, mandated to mitigate the negative affects of development, has provided brushy wildlife habitat islands surrounded by homes.

Figure 4. A coyote with little fear of humans is easily seen during daylight hours on an urban street in San Bernardino County, California.

The diet of coyotes in wildland areas has been found to consist of numerous mammals, birds, reptiles, arthropods, fruit, seeds, and greens from plants (Sperry 1941; Ferrel et al. 1953; Korschgen 1957; Gipson 1974). Most people who have researched the wildlands coyote's diet conclude that coyotes are omnivorous feeders and opportunistic predators (Van Vuren and Thompson 1982), using a wide range of foods depending on seasonably, behavioral imprints, parental influence, and the make-up of the surrounding environment. Others have observed that, in general, coyote food habits tend to reflect the composition of the local prey base (Fichter et al. 1955; Knowlton 1964). Typically, rodents and rabbits are dominant components of a coyote's diet.

A recent study in Arizona compared diets of coyotes frequenting rural versus suburban areas near Saguaro National Monument East (McClure et al. 1995). The investigators noted that suburban coyotes consumed human related foods (e.g., pet food, bread, and other human related items) as partial substitutes for the more natural foods eaten by their rural counterparts. The suburban coyotes also were seen to consume fewer plant items (e.g., mesquite pods, prickly pear fruits) year-round, and they ate fewer mammalian prey during the breeding and gestation seasons than did rural coyotes.

At least three studies have reported coyote diets in and around urban areas of southern California. MacCracken's (1982) study site was a semi-rural area on the edge of El Cajon, a suburb of San Diego. He found "garbage" (eggshell, plastic and cellophane, cloth, string, etc.) to total 167% of all items encountered in coyote scats (feces). Additionally, chicken comprised 8.3% of all items; and plant seeds, which he noted were primarily from melons, comprised 16.8%. While it is difficult to know whether the chicken and various plant materials were taken as refuse, he concluded that the occurrence of these items was a clear indication that coyotes were capitalizing on human provided food sources.

Shargo (1988) reported briefly on food habits of coyotes in Malibu, a suburban area of Los Angeles County. Plant materials were found in 81.8% of all scats, rodents in 45.5%, "garbage" in 40.9%, domestic cat in 13.6%, mule deer in 9.1%, and small bird in 4.5%. His data are expressed as percent occurrence in scats; a single scat typically contained multiple items, so the sum of percentages exceeds 100%. Thus, it is difficult to make a direct comparison to MacCracken's data. Shargo noted that several radio-tracked study animals foraged extensively in suburban backyards adjacent to canyons, although different degrees of utilization of suburban areas were noted among individual animals. Among his conclusions was that human activities have produced a productive habitat for coyotes, with a plentiful food supply that is available year-round.

Wirtz (1982) conducted several food habits studies in different southern California habitats. Among other conclusions, he noted that urban coyotes killed during control activities in Glendale, California relied heavily on "garbage" as a food source, on the basis of stomach analyses he performed. In fact, on the basis of percent frequency of occurrence, 67% of food items fell into this category. While he classified such items as avocado, zucchini, and carrot as "garbage," it is impossible to know if suburban refuse was the actual source for these specific items, or whether coyotes were actively using urban gardens and fruit which fell from backyard trees. Scat analysis from two sites in Claremont, California (one urban, one rural) revealed that seasonal frequency of food items utilized was similar in the two habitats, in regard to fruits, woodrats, and meadow voles. However, urban coyotes in Claremont relied heavily on fruits and Jerusalem crickets in the fall and on pets and rabbits in the winter and spring.

Aside from animals' innate behavioral traits, learned behaviors assist in their adaptation to specific circumstances. Lehner (1976) discusses learned predatory behavior in coyotes, and he speculates about the role of observational learning and learning through communication. The coyote has been shown to adapt to a wide range of habitats. The authors speculate that its recent adaptation to urban and suburban habitats in places such as southern California has taken place over several generations, and such adaptation may involve learned behaviors passed from parent to offspring. If such adaptation occurs at different rates in various family groups, this could explain why there appear to be several behavioral "types" of coyotes using urban areas. Those most closely adapted to contact with humans may dwell entirely within the urban area, while others rest and den in the wildland fringe areas, entering the urban area for food and water. The less the fear of humans, the more often the coyote enters urban areas. There are also coyotes that apparently only enter seasonally as transient, non-territorial animals. Shargo (1988) and Wirtz et al. (1982) observed such behavioral differences in their study animals.

Wells and Lehner (1978) concluded that the coyote's primary senses used in locating prey (rabbits) were vision, audition (sound), and olfaction (smell), in this order of priority. All three senses are well developed in coyotes. Connolly et al. (1976) and others have demonstrated the coyote's innate ability to stalk, attack, and kill prey. Even coyotes born in captivity, or raised in kennels from the time they were pups, demonstrate stereotypic predatory behavior. Captive coyotes that had no previous prey-killing or hunting experience were shown to kill 30- to 70-1b. lambs when given the opportunity. Most coyotes approached the sheep and stalked them prior to attack. Fleeing sheep were always chased and usually attacked; Lehner (1976) also noted that movement of the prey, particularly attempting to flee from the coyote, is a stimulus that triggers an attack. The killing method on sheep was consistent, with each coyote clamping its jaws on the lamb's neck, eventually suffocating the sheep in manner mirroring that of wild coyotes (Connolly et al. 1976).

In the wild, coyotes usually trot slowly and quietly while hunting. When prey are spotted, the coyote often freezes, and then pounces to attack. A "stalk and pounce" sequence is often seen when prey are small, and this behavior can be observed in coyote pups as young as 32 days of age (Young and Jackson 1951; Bekoff 1977, 1978). For larger prey or for prey farther away, they will quietly stalk until the right time for attack. They then often pursue the prey, biting the neck, and quickly stopping to hold the prey until no fight is left. When prey is located, coyotes appear to "lock" onto the target, switching from a foraging or ranging (travel) mode to a kill mode. It seems during this kill mode, when they are "locked-on," it is difficult to break the attention of a coyote or to dissuade it from attack. Researchers who have observed coyotes preying upon domestic animals have noted this singular focus on a selected prey, almost to the exclusion of extraneous stimuli (G. E. Connolly and F. F. Knowlton, pers. comm.). Those coyotes having less than the usual fear of humans would likely be even more difficult to chase away from prey. In the cases previously discussed, several coyotes that attacked humans were noted to remain close to the victim after being pulled or, beaten off. When later shot by police, they were a few yards away and still in sight of the person who was attacked.[1,2,3]

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[1] Several news articles including the *Tahoe Daily Tribune*, South Lake Tahoe, California, (February 18 & 19, 1997).

[2] Interview with Rebe McDaniel (March 1997), San Clemente, California, after daughter was attacked.

[3] Interviews with Douglas String (January 1997), San Juan Capistrano, California, and review of hazard/incident reports filed by attack victims and witnesses.

CHANGING SOCIAL VALUES AND, HUMAN BEHAVIOR

Most citizens enjoy watching wildlife, especially in natural settings such as national, state and local parks, wildlife reserves, and in other native wildland areas. In the past, most people held a proper respect for the danger posed by wildlife, especially the larger predators. However, attitudes of many people in today's society toward wild animals have changed from respect and fear to a certain reverence. This new attitude applies not only to large, dangerous predators, but even to small rodents that may carry disease.

Where coyotes have become a problem, trash handling is often poor. Most cities no longer allow plastic bags of refuse to be placed out for collection; however, the trash cans being used often are not tight-locking and are easily opened if knocked over by dogs or coyotes. At one problem commercial site, several large trash compactors were found to be leaking grease and other liquids and were frequented by coyotes.

Recycling is valued in today's society, but a compost pile was found to be a primary source of attraction to coyotes visiting one yard where a young girl was attacked. Coyotes also used an attractive koi pond next door for water and an occasional dinner.

A feral cat colony served as an attractive food source at one problem site. The coyotes eventually killed most of the cats and continued to feed on the cat food placed daily by well-meaning citizens. At many sites, cottontail rabbits were also a source of attraction to coyotes on park, golf course, and homeowner association common areas. Cottontail rabbits were formerly controlled throughout California by use of anticoagulant baits, but only two California counties still have baits labeled for this use. Cottontails are a highly attractive food source for coyotes. Public complaints about the use of poison bait to kill rabbits has led to a reduction in rabbit control, despite the serious damage they cause to landscape plantings (Richard LeFeuvre, Orange Co. Agric. Commissioner, pers. comm., 1997).

Many well-meaning citizens who feed wildlife, or who provide abundant resources for wildlife in their yards out of their desire to enhance viewing of wild vertebrates, may be doing serious harm. Such food sources can encourage populations of wildlife that far exceed an area's carrying capacity. Supplemental feeding also can change the animals' natural instincts relating to finding food, and change their behavior toward people. These conditions often lead to an increase in human-wildlife conflicts (Jurek 1997).

While people find it enjoyable to maintain bird feeders, even this activity can contribute to problems. Feed left on the ground or otherwise accessible will attract rodents and their predators, including coyotes. Many who feed birds do not realize how clean they must keep the area, or how to keep rodents out of the feeders. The authors have seen many rodent and predator problems caused by well-meaning birders. The senior author, responding to coyote complaints at various locations in southern California, has spoken to several homeowners who formerly fed birds and small animals until skunks, raccoons, and coyotes became a problem. Self-activated pet feeders and waterers are used by many until they learn about who's coming to the food or water besides the pet.

The most irresponsible human behavior contributing to coyote problems is actual feeding and watering of predators in urban, suburban, and park settings. In several parks and residential areas, people have been observed throwing scraps and bones to coyotes. Such activities can quickly habituate coyotes to dependence upon human provided foods, as well as extinguishing coyotes' normal wariness of people. The feeding of coyotes is noted as a contributing factor to subsequent attacks that were described by Parker (1995).

Within the last two decades, the significant reduction in both coyote and rodent control programs in California, formerly provided by county agricultural commissioners, local health departments, and the USDA's Animal Damage Control (Wildlife Services), may be another factor related to the increase in coyote attacks on humans. These programs were often viewed as agricultural or rural services. Ironically, their demise has more significantly affected the urban citizens, who demanded the tax cuts, than the ranchers. Perhaps more important than the increase and spread of coyotes is a resulting change in coyote behavior: coyotes have ceased to regard humans as enemies, but instead perceive people to be a source of food. Coyote damage control programs have commonly relied on the use of leghold traps and on shooting; both techniques augmented and reinforced the coyotes' natural fear of humans. Curtailment of sport hunting and target shooting around urban and suburban areas has also reduced coyotes' opportunity to learn to be wary of humans. A basic law of nature is that animals must avoid destruction by their natural enemies (Young and Jackson 1951). It is adaptive for coyotes to maintain their fear of humans, as their only other natural enemies are the mountain lion (*Felis concolor*) and wolf (*Canis lupus*). Yet, in urban areas of southern California, this fear has at times been lost because of changing human behaviors.

INTEGRATED METHODS FOR WILDLIFE PROBLEM REDUCTION

Prior to initiation of any project to prevent or control coyote-human conflict, a well-qualified wildlife biologist should evaluate the situation to properly identify the problem and assure that all possible solutions are considered. The necessary initial information includes correct identification of the predator, presence of active coyote trails, prey base (from feces. and other evidence), non-target activity, hazards, possible prevention practices, public attitudes, and time frames.

Public education is an integral component of programs to prevent or reduce human-wildlife conflicts. All public education materials should discuss haw to avoid attracting wildlife (not just coyotes), and methods to maintain in wildlife a fear of people. The text should explain practical methods of using exclusion fencing, sanitation, and scaring or frightening techniques. Where coyotes have already become a problem, advice on how to react when approached or attacked by animals is important to include.

Sanitation is a key consideration in preventing

modification of the coyote's inherent fear of humans. It must be stressed that it is critical to keep food and water inaccessible. Pet food must always be kept indoors or cleaned up after the pet has fed. "Animal proofing" is essential to exclude predators from composting sites and other attractive areas. Trash receptacles in parks or near urban fringe areas must be animal-proof. Tree fruit, get food, and household garbage must be removed from yards and neighborhoods, and small pets must be kept indoors or in well-fenced kennel areas at all times. Limiting rodent and rabbit populations reduces the area's attraction to predators. Homeowners can exclude rabbits from rear fenced yards by installing rabbit fences of one-inch poultry netting, buried six inches into the soil and extending 30 inches or more in height. Electric fencing can be very effective to keep coyotes from coming over or under walls and fences, but such fences must be installed using very tight construction and with an effective grounding system.

When planning landscape projects, avoid ornamentals such as ivy, grape ivy, other vines, prostrate myoporum, or other such plants that produce fruit or that attract rabbits and rats. Maintain ground covers so they are kept low and thin. Keep skirts of shrubs and trees near wildland areas or near children's play areas pruned up several feet off the ground.

Many caring and well-meaning individuals unintentionally create human and pet safety problems by adding food to the wild predators' habitats. This action may change the social behavior of coyotes from being naturally wild and wary of humans, to actual dependence on them for food. Communities should develop ordinances against feeding wildlife, and they must back them up with enforcement. Numerous agencies and homeowner associations have developed effective rules to prevent wildlife feeding, including the maintenance of unsanitary bird feeders.

Scaring devices can be used when coyotes are seen. Check with local authorities regarding noise and weapons ordinances. A few of the successfully used items are include starter pistols, .22-caliber blanks, portable air horns, auto horns, propane cannons, halogen spotlights, slingshots, and rocks. Where legal, B.B. guns and low-powered pellet guns, using blunt pellets while aiming for the body rather than the head, can be effective. Rubber shot and slugs have also been used, but these can be dangerous and cannot be used where firearms are prohibited.

The City of Glendale has one of the best programs to date. Captain Michael S. Post of the Support Services Division, Glendale Police Department, runs the program. Captain Post's letter of introduction to citizens with coyote problems prudently states, "The prevalent scientific view prescribes educated co-existence as the only realistic long term solution for coyote-human conflicts." Citizens experiencing wildlife problems are sent an information packet including information on fencing, habitat modification including recommended sanitation practices, human and wildlife behavior, coyote biology, city wildlife anti-feeding ordinances, and the use of oleoresin of capsicum (pepper spray). Trapping and euthanasia are done only after citizens have tried all recommended methods to avoid the problem, or when public safety is immediately at risk. The program has been greatly successful in eliminating problem coyote populations by removing a few coyotes and reinstating the fear of humans and urban areas into the predators.

POPULATION REDUCTION AND BEHAVIORAL MODIFICATION

When use of the above-mentioned methods has not modified coyote behavior sufficiently to prevent conflicts, or when signs of human safety risks are developing, the following methods have proven to be effective. They can be used not only in removing the problem animals, but also in scaring and modifying the behavior of the local population. Coyotes not trapped or shot will then predictably move out of the area, and typically they will avoid humans for several years.

Leghold trapping using a No. 3 Victor Soft Catch® or other padded traps is quite effective. When modified with double swivels, shock springs, and a short chain (usually 12 to 16 inches total length), the humaneness of this already humane trap is increased. Pan tension devices, when installed and set for four pounds or greater, prevent capture of smaller species. Use of these modifications and expert trap placement reduces non-target capture and decreases stress on non-targets prior to their release from the trap. Traps may be checked twice daily in urban areas, where capture of non-target species is possible, and to reduce the chance of someone approaching a trapped coyote. The senior author is unaware that any domestic pets have been seriously injured by capture in these safer traps, in thousands of sets. The only injury that required veterinary treatment was a cat that the owner injured while removing it from the trap, instead of waiting for the biologist's assistance as had been recommended. Dogs are rarely found running loose in a coyote project area, and few cats are seen. Cats usually do not spring traps equipped with pan tension devices.

Of all techniques, trapping has the greatest observed effect of re-instilling the fear of humans in coyotes. When coyote attacks on pets have begun to occur in an area, it is imperative that the problem be corrected by use of trapping, so as to prevent escalating human-coyote problems including attacks on people. A seven- to ten-day trapping period using careful, selective trap placement in areas frequented by the offending coyotes is usually sufficient to re-instill their fear of humans. Eradication of all coyotes in the area is neither attempted nor necessary. The coyotes using the area often disperse after trapping and euthanasia of two to five coyotes; this is partially dependent on the size of the area, the number of coyote family units using the area, and the existing level of fear in the behavior imprint of the coyotes. It is harder to modify the behavior of coyotes that have been using urban areas for generations. Often this requires taking coyotes in greater numbers, and sometimes a second trapping phase is needed. All coyotes caught must be euthanized according to American Veterinarian Medical Association standards, as relocation is neither biologically sound, legal, nor humane. Further, there are legal liability issues involved when problem animals are

relocated to a place where they may continue to be hazards to human safety. On all projects where trapping has been employed, coyote problems have not reoccurred for at least two years, usually longer. If other recommendations are followed and people do their part, trapping may only have to be conducted once in each problem area.

Cage traps are only recommended for attempting to capture sick or very young coyotes. Cage traps are ineffective at capturing most coyotes (Howard et al. 1985; Loven 1995; and personal experience). When coyotes and other wild animals are caught in cage traps, they are usually in much worse physical condition than those caught in soft catch leghold traps. Some cities in Los Angeles County, through experience, have found that leghold traps usually have to be employed if the goal is to capture coyotes. Only in instances of trying to capture starved or juvenile coyotes do they attempt to use cage traps, employing the services of the Los Angeles County Agricultural Commissioner.

Shooting is very limited in its feasibility in urban areas, and it must always be coordinated with local law enforcement agencies. The wildlife biologist's evaluation is especially important prior to shooting, and the biologist should use only experienced personnel on the project. Safe shooting zones must be identified, residents or property owners notified, and target animals and safe backgrounds checked by an experienced non shooting safety team leader before shots are fired. Several varmint-type rifles and shotguns can be effectively used. There are new types of safer ammunition now available, so check with a knowledgeable supplier before purchasing ammunition.

DISCUSSION

Human-coyote conflicts have become common in southern California and in other areas. Attacks on humans by coyotes are no longer rare. They should be viewed as a real risk for children and adults, but they are preventable. The risks are greatest in suburban-wildland fringe areas and other brushy areas that are frequented by people. The authors believe state and local officials need to start collecting data on coyote attacks on pets and humans in order to better evaluate problems existing throughout the state. These data could also predict developing human-coyote conflicts, allowing for timely prevention in many cases.

Signs of coyote behavior that indicate a human safety risk appear to be quite clear, as evidenced by descriptions of the cases discussed above. These signs are, in order of their usual patterns of occurrence:

a. Increase in taking of pets at night
b. Increase in observance of coyotes on streets and yards at night
c. Daylight, early morning and late afternoon, observance of coyotes on streets and in parks and yards
d. Daylight observance of coyotes chasing or taking pets
e. Taking pets on leash and chasing joggers, bikers, etc.
f. Coyotes seen in and around children's play areas and parks in midday.

The motive for predatory behavior of coyotes is not always hunger (Connolly et al. 1976) or protection of dens, as demonstrated by many of the attacks discussed in this review. While the availability of food from humans in urban and park settings contributes to the attractiveness of the habitat to coyotes, their loss of fear of humans would not occur without a lack of aggression by people. Human activities, including organized trapping programs, sport hunting, and other activities that resulted in scaring coyotes away, reinforced the coyote's inherent wariness of people. But, changes in human attitudes toward the protection of all wildlife have resulted in coyotes, taking advantage of their opportunity to frequent prey-rich, human-created environments without harassment.

Authorities and citizens must act responsibly to correct coyote behavior problems before they become a public safety hazard. It is the experience of the senior author, and of persons interviewed, that when action is taken before pet attacks are a common occurrence, further problems can be avoided. However, this requires that aggressive actions and use of scaring devices be initiated promptly when coyotes are seen or heard close to residences. If pets are being taken frequently, or if other food sources have been used for a long period of time, leghold trap use is the best and longest-lasting behavior modification tool. An initiative measure submitted for the November 1998 California ballot will, if passed, ban or severely limit the use of leghold traps.

The City of Glendale demonstrates what a responsible and effective program can do. People are educated to better coexist with wildlife. When necessary, coyote behavior is modified by institution of a limited trapping program. Before the education and trapping control program was initiated, numerous human attacks from coyotes had occurred, including the tragic death of a child in 1981. Reports of humans being harassed within the city are now uncommon, and no bite cases have been recorded for more than 10 years due to the success of the program. Pet attacks were also very common, and pets were shown to comprise a measurable portion of the coyote diet (Wirtz et al. 1982). Over the last four years, a low incidence of pet attacks has been reported, averaging slightly more than four cats and one dog lost per year. This compares to much smaller communities that report 20 to 50 pet losses per year (Capt. Michael Post and Lenaee Dunn, City of Glendale Police Dept., pers. comm.).

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