

Coyotes are thriving in virtually every urban area in the country; biologists who study the predators say they pose no threat to people—as long as we let them stay wild

BY DOUG STEWART

Last March, a full-grown coyote made headlines when it led a posse of heavy-breathing police officers, city officials and reporters on a zigzagging chase through New York City's Central Park, where it was finally subdued with a tranquilizer dart.

To most of the public who watched video footage of the chase the next day (thanks to the five news helicopters that had followed along), the saga of the coyote in midtown Manhattan

A COYOTE RESTS on a seat after jumping onto a light-rail train at Portland International Airport in Oregon. Captured by a wildlife official before the train left the station, the animal was released safely far from the airport, where it immediately began chasing field mice.

IN DOWNTOWN Vancouver, a coyote strolls through a park (right); two others explore a cemetery (far right) across town. According to biologist Stan Gehrt, who is radio-tracking nearly 200 coyotes in Chicago, "coyotes that have been born and raised in urban areas prefer urban areas."

seemed utterly bizarre. The coyote, however, was likely a native New Yorker, quite possibly even a Bronx resident. It just picked the wrong time and place to show itself.

From coast to coast, coyotes have become a fact of life in urban America. They howl in downtown Chicago, trot across Wilshire Boulevard in Beverly Hills and dig dens in and around Tucson, St. Louis, Boston, Detroit and Washington, D.C. "Coyotes that have been born and raised in urban areas prefer urban areas," says wildlife ecologist Stan Gehrt of Ohio State University, who has radio-collared nearly 200 coyotes in the Chicago area over the past six years. "It's not a matter of coyotes being pushed out of better habitat and into a city. For the majority of these animals, they're home. They're where they want to be."

While these four-footed neighbors are bound to make some city dwellers nervous—coyotes are carnivorous, after all—Gehrt and other wildlife experts say there's no reason we should feel threatened. Most coyotes avoid contact with people so thoroughly that we're lucky if we see one at all; learning to be wary is part of a pup's upbringing. The key to coexisting is to not undo what coyotes have learned so well.

Few wildlife success stories are as dramatic as that of *Canis latrans*. "If you go back 200 years, Lewis and Clark didn't stumble on coyotes until they got to what is now the Dakotas," says Matthew Gompper, a wildlife biologist at the University of Missouri. Coyotes were originally grassland animals, he says. The disappearance of huge swaths of forest helped them expand their range, as did the eradication of wolves, their chief predators. Expanding beyond the rural West over the past century—despite efforts



early on by farmers and ranchers, with federal help, to exterminate them—coyotes now reside in every state except Hawaii. Their infiltration into cities and suburbs in recent decades,

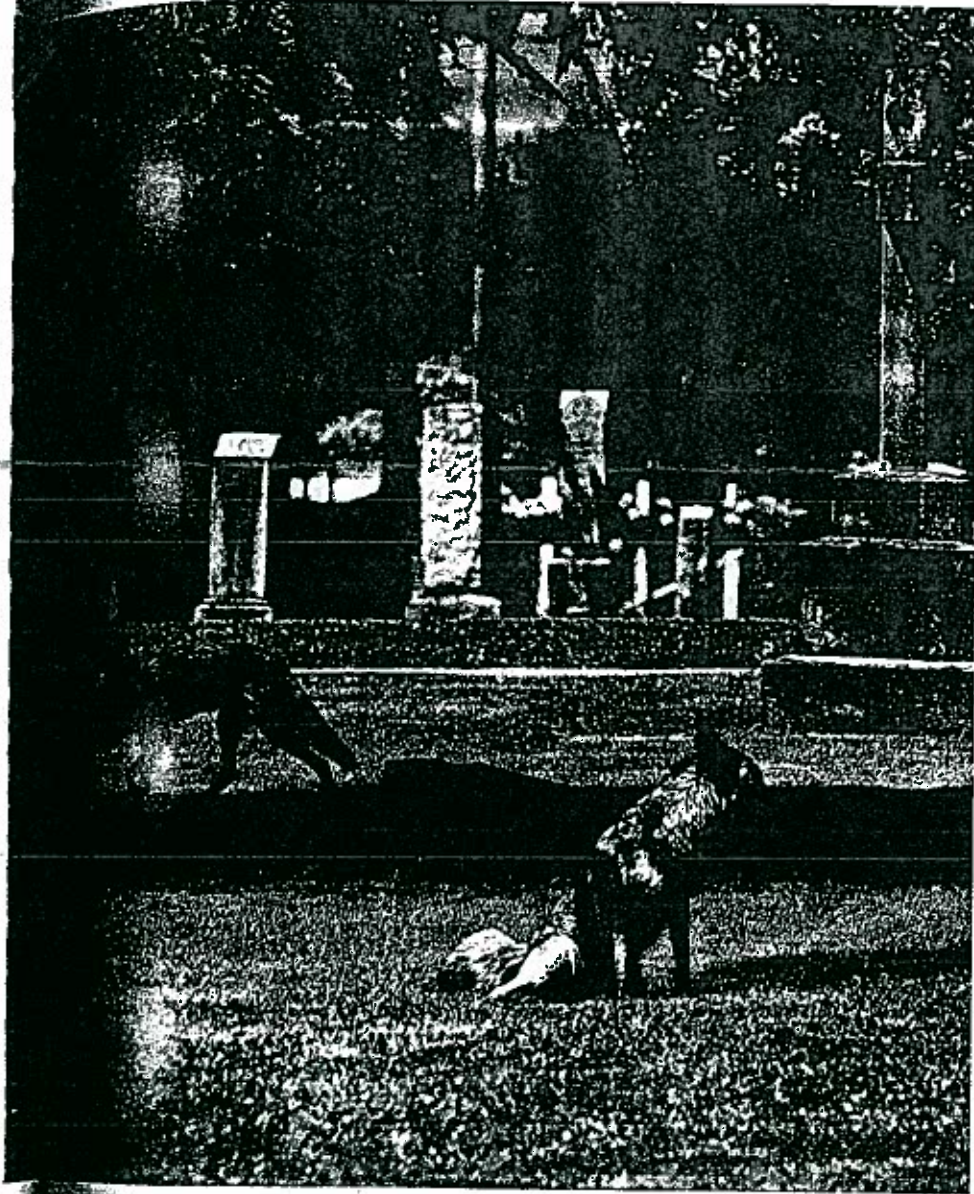
coyotes are probably much more common than people realize."

No one knows how many coyotes live in urban areas. Their total U.S. population could be anywhere from

"COYOTES DEFINITELY LEARN HOW TO CROSS ROADS. THEY HAVE TO. SOME OF THESE GUYS CROSS HUNDREDS OF ROADS EVERY NIGHT."

Gompper says, is simply a side effect of their overall range expansion. "At this point, all cities have them. Urban

one to ten million. The sense that their numbers are on the rise is based in part on increases in phone calls to anti-



HOW TO: **BE A GOOD NEIGHBOR**

URBAN COYOTES are here to stay, so we need to learn how to coexist with them.

The predators can make perfectly good neighbors as long as they don't lose their natural fear of us.



Some tips:

- Don't feed coyotes! Avoid overflowing bird feeders and open compost bins.
- Obey leash laws. Small dogs on the loose are attractive prey for coyotes, especially at night. Cats? Keep them inside, along with pet food bowls. In dry climates, even a water bowl can draw coyotes.
- Keep all garbage containers closed and inaccessible. Adding ammonia or pepper spray to trash can discourage rummaging by coyotes and other wildlife.
- Don't invite coyotes to build dens next to (or under) your home: Seal crawl spaces, close sheds and thin brushy areas.
- Even if you love seeing coyotes, don't let them know it. If a coyote visits your yard, wave your arms, shout, spray it with a hose. Be a threat!

mal-control officers about coyote sightings. Some of this increase no doubt stems from a heightened awareness of coyotes and what they look like, thanks to sometimes sensationalistic press coverage.

Most coyotes manage to operate unobserved, mainly due to their preference for the wee hours between midnight and dawn. They may visit your backyard regularly, but not while you're awake. Urbanites who do cross paths with coyotes can easily mistake them for unleashed dogs. With their large, upright ears and bushy tails, they look a bit like small German shepherds but with lighter frames and narrow, foxlike muzzles. In the west-

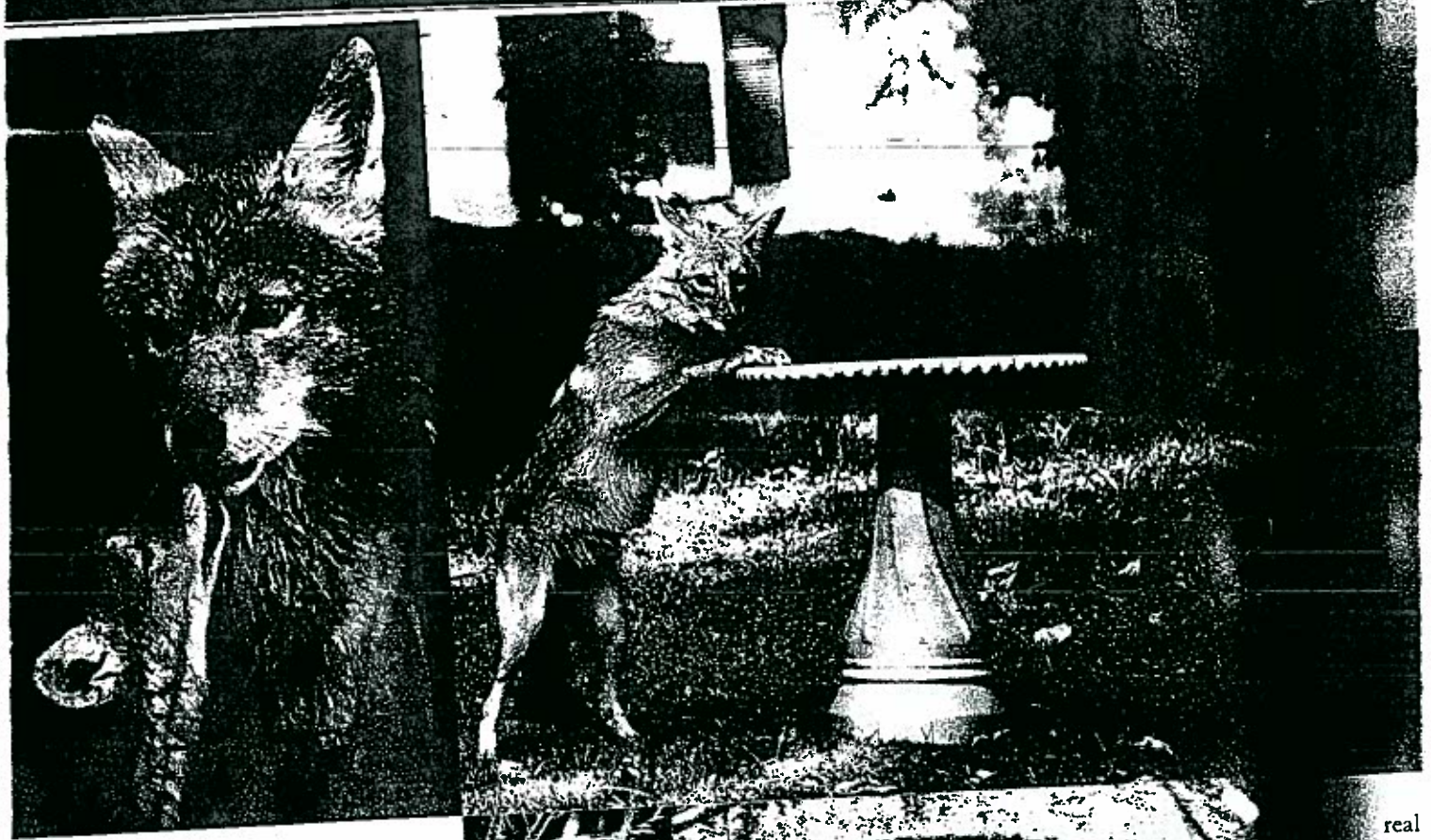
ern United States, adults typically weigh between 20 and 30 pounds, though their heavy coats can make them appear larger. Eastern coyotes average 10 pounds more; some reach 50 or 60 pounds. Their larger size may be due to crossbreeding with wolves sometime in the past.

A modern city might at first seem like marginal habitat for a coyote. Not so, says Paul Krausman, a University of Arizona wildlife biologist who is studying two groups of coyotes living in downtown Tucson. "Coyotes are one of the most adaptable species on the face of the Earth," he says. "In urban areas, they've got everything they need. There are no wolves or

mountain lions, so they're at the top of the heap. People are throwing out garbage for them to eat, and they're watering their lawns, which attracts prey species. It's a perfect setup."

In dietary matters, coyotes are opportunists, which is one reason they're able to make themselves at home while surrounded by people, cars, buildings and asphalt. Strictly speaking, they're more omnivores than carnivores. Their diet consists of mammals like deer (fawns in spring, roadkill year-round), raccoons, rabbits, mice and, when the opportunity presents itself, cats and small dogs, but also birds, insects, berries and other fruit. An urban coyote's natural diet is often supplemented by anthropogenic food items like pet food and trash.

How this latter, unintended smor-



gasbord is affecting coyotes is among the questions that Paul Curtis, a wildlife specialist at Cornell University, hopes to answer. Curtis is involved in a five-year investigation, begun in 2005, of urban and suburban coyotes in New York state. While most of his data are preliminary, Curtis can already confirm the coyote's legendary wiliness: Trapping study animals has not been easy. He and his colleagues mask their own scent by dyeing and waxing their traps and handling them with special gloves. They even avoid kneeling on the ground. "We go through all this effort, and several times last month we've had coyotes come in, know exactly where the trap was, dig all around it, and urinate on it, as though they're saying, 'Ha! You didn't get me.'"

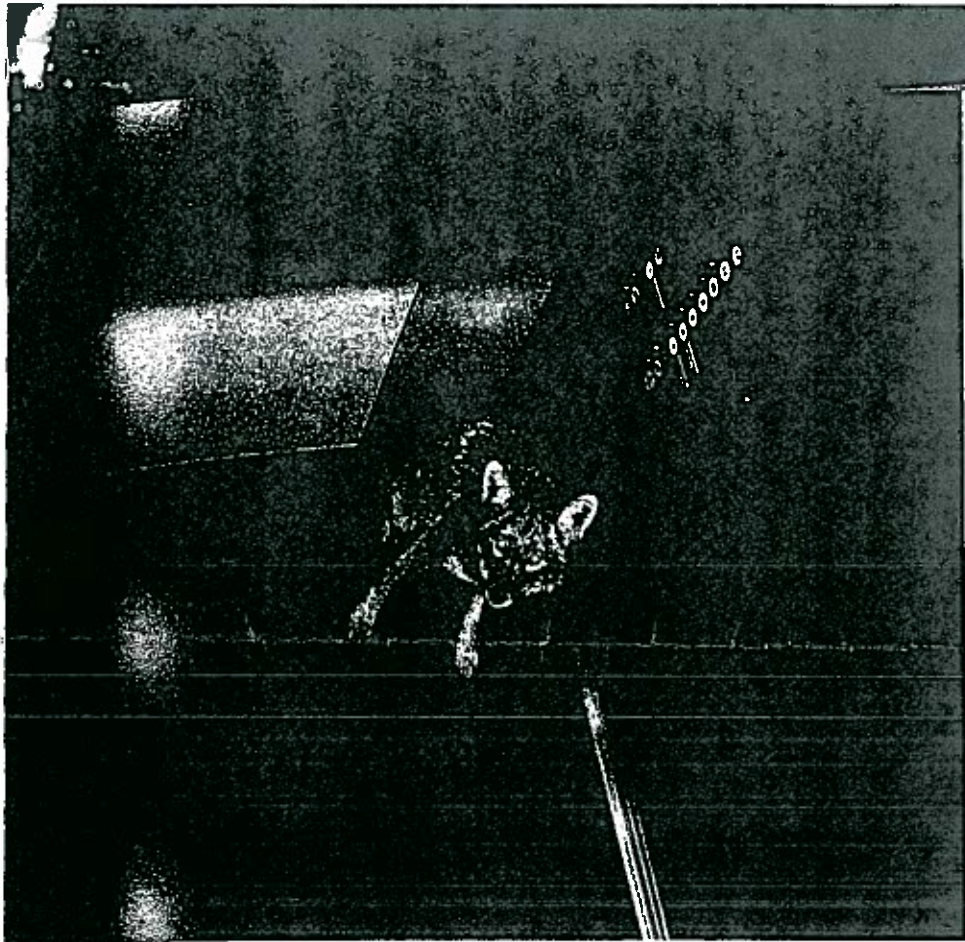
The most extensive study of urban coyotes is in Chicago, where Gehrt has been monitoring up to 40 radio-collared animals at a time. He reports a number of surprises. "People used to think large carnivores needed big tracts of undeveloped habitat to be successful," Gehrt says, "but we found that's not true in Chicago." Those living in packs and defending a territory,

he says, use a range of between two and eight square miles. "It can include some of the most urbanized land you can imagine." One group he's monitoring lives at the corner of two major interstate highways, with the country's second-largest indoor mall alongside. Not surprisingly, collisions with vehicles represent a Chicago coyote's number-one mortal-

ity risk, accounting for 70 percent of the deaths that Gehrt has tabulated. Still, the animals aren't blundering through the city like disoriented moose. "Coyotes definitely learn how to cross roads," he says. "They have to. Some of these guys cross hundreds of roads every night." The most impressive example of coyotes making do with scarce urban

real
anir
sing
ipal
cent
you
drei
kne
he's

nu
der
I
der
of
ur
be
na
rel
w
w
bl



AT HOME almost anywhere they roam, coyotes have been spotted in Wyoming fields (with young, far left), suburban Cincinnati (drinking from birdbath, middle left, top) and beside the main runway at Kelso-Longview Regional Airport in Washington state (peering from culvert, middle left, bottom). An exception, this coyote stuck in an elevator in downtown Seattle (near left) had been chased into the building by crows and was trapped and later released.

real estate, Gehrt says, was a pair of animals that dug their den under a single line of bushes between a municipal swimming pool and a day care center. "They were able to raise their young a few yards from where children were playing, and hardly anyone knew they were there," he says. Unless he's aware that a coyote has become a

(A coyote thinks nothing of trotting 20 miles in a night.) And if it didn't, another coyote might well take its place. "No matter what anyone might try to do to remove coyotes from cities and suburbs," says Curtis, "they're going to be there."

Jim deVos is research chief for the Arizona Game and Fish Department

extremely rare, but they do happen. In southern California, over the past 25 years especially, some coyotes have become brazen, prowling in the daytime and even openly following people walking small dogs. The only known fatality was a young girl attacked by a coyote in suburban Glendale, California, in 1981. Biologists believe that dangerous coyotes are those that have become habituated to humans. Unsecured trash cans, overfilled bird feeders and outdoor pet bowls have been part of the problem. In many cases, however—including that of the Glendale animal—they are fed intentionally as part of a homeowner's misguided nature-watching strategy.

Gehrt knows that a few Chicagoans have begun feeding the local coyotes,

"IT WILL BE INTERESTING TO SEE IF WE CAN CHANGE PEOPLE'S BEHAVIOR BEFORE PEOPLE CHANGE THE COYOTES' BEHAVIOR."

nuisance, Gehrt avoids publicizing den sites.

Indeed, more than a few city residents are uncomfortable with the idea of coyotes in their midst. Once an urban coyote is trapped, some people believe it should be removed to a nature preserve somewhere, not released into the very neighborhood where it was found. Even if a coyote were to be relocated, it might be capable, like Lassie, of coming back home.

in Phoenix, where coyotes are well-entrenched residents. The urban public, he's noticed, is divided in its views about coyotes. "We've held neighborhood meetings where half the group sits on one side of the room and half on the other," deVos says. "One side wants them gone. They say, 'I'm scared to death of them. They're going to eat my children.' The other side says, 'Boy, that's cool! I got to see one.'"

Coyote attacks on humans are

just as some urban Californians have for decades. "When I tell them they need to stop, they get upset," he says. "Not just a little bit. We're talking irate. It will be interesting to see if we can change people's behavior before people change the coyotes' behavior."

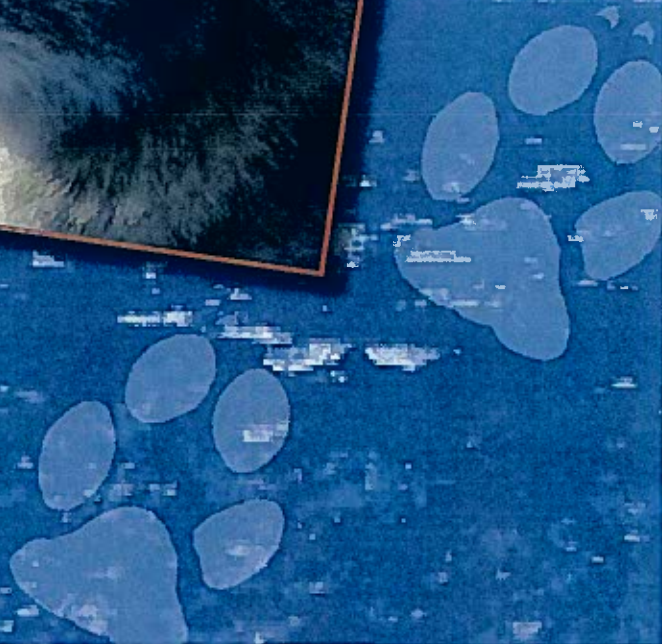
DOUG STEWART, a regular contributor, doesn't mind sharing his Massachusetts neighborhood with coyotes, but he keeps his puppy inside at night.



Urban Coyote Ecology and Management



The Cook County, Illinois, Coyote Project



Author

Stanley D. Gehrt
School of Environment and Natural Resources
The Ohio State University

Acknowledgments

This project has been supported primarily by Cook County (Illinois) Animal Control, with special support from the Max McGraw Wildlife Foundation and the Forest Preserve District of Cook County (FPDCC).

In particular, we would like to thank Dr. Dan Parmer for his support. Chris Anchor, FPDCC, has provided invaluable assistance with many aspects of the project. Rob Erickson was contracted to assist with coyote trapping. Many technicians and volunteers associated with the Max McGraw Wildlife Foundation have contributed to radio-tracking and processing captured individuals. Paul Morey radio-tracked coyotes and conducted diet analyses. Justin Brown provided information on coyote predation on goose eggs.

Dr. Mike Kinsel and the Zoological Pathology Program, University of Illinois Laboratories of Veterinary Medicine, performed necropsies; Dr. John Andrews at the University of Illinois assisted with serology; and Dr. Tom Meehan and his staff performed fecal analyses.

Dr. Jean Dubach, Brookfield Zoo, is performing genetic analyses of radio-collared coyotes. Robert Boelens, Stanley Park Ecology Society; Brian MacGowan, Purdue University; and Dr. Gary San Julian, Pennsylvania State University, kindly provided external reviews that greatly improved the manuscript.

Production

Editing, Joy Ann Fischer, Communications and Technology
Design, John K. Victor, Communications and Technology



Ohio State University Extension embraces human diversity and is committed to ensuring that all educational programs conducted by OSU Extension are available to clientele on a nondiscriminatory basis without regard to race, color, age, gender identity or expression, disability, religion, sexual orientation, national origin, or veteran status.

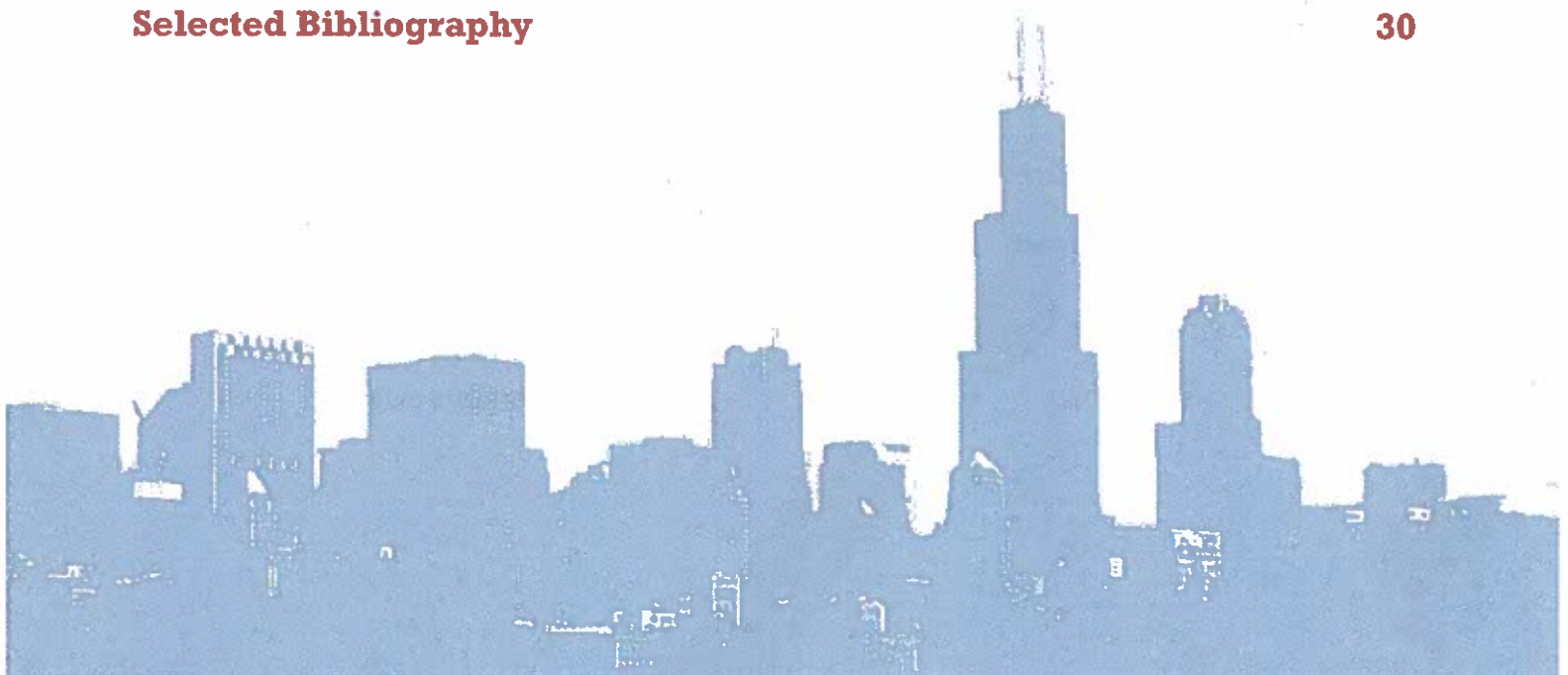
Keith L. Smith, Associate Vice President for Agricultural Administration and Director, Ohio State University Extension

TDD No. 800-589-8292 (Ohio only) or 614-292-1868

11/06—3M—PS JOB #XXXXXXXXXX

Contents

Ghosts of the Cities	4
The Cook County, Illinois, Coyote Project	5
Ecological Characteristics of Urban Coyotes	7
Where Do Coyotes Come From?	7
What Do Coyotes Look Like?	8
How Do I Know If Coyotes Are Present?	10
Do Urban Coyotes Form Packs?	11
How Long Do Urban Coyotes Live?	12
When Do Coyotes Have Young?	14
What Do Urban Coyotes Eat?	15
Where Are Urban Coyotes Found?	16
What Good Are Coyotes?	19
What Effect Do Coyotes Have on Other Wildlife?	21
Conflicts Between Coyotes and Humans	22
Are All Coyotes a Threat to People?	23
What Creates Nuisance Coyotes?	23
Management Options	26
The Future	28
Implications from the Cook County Coyote Project	29
Selected Bibliography	30

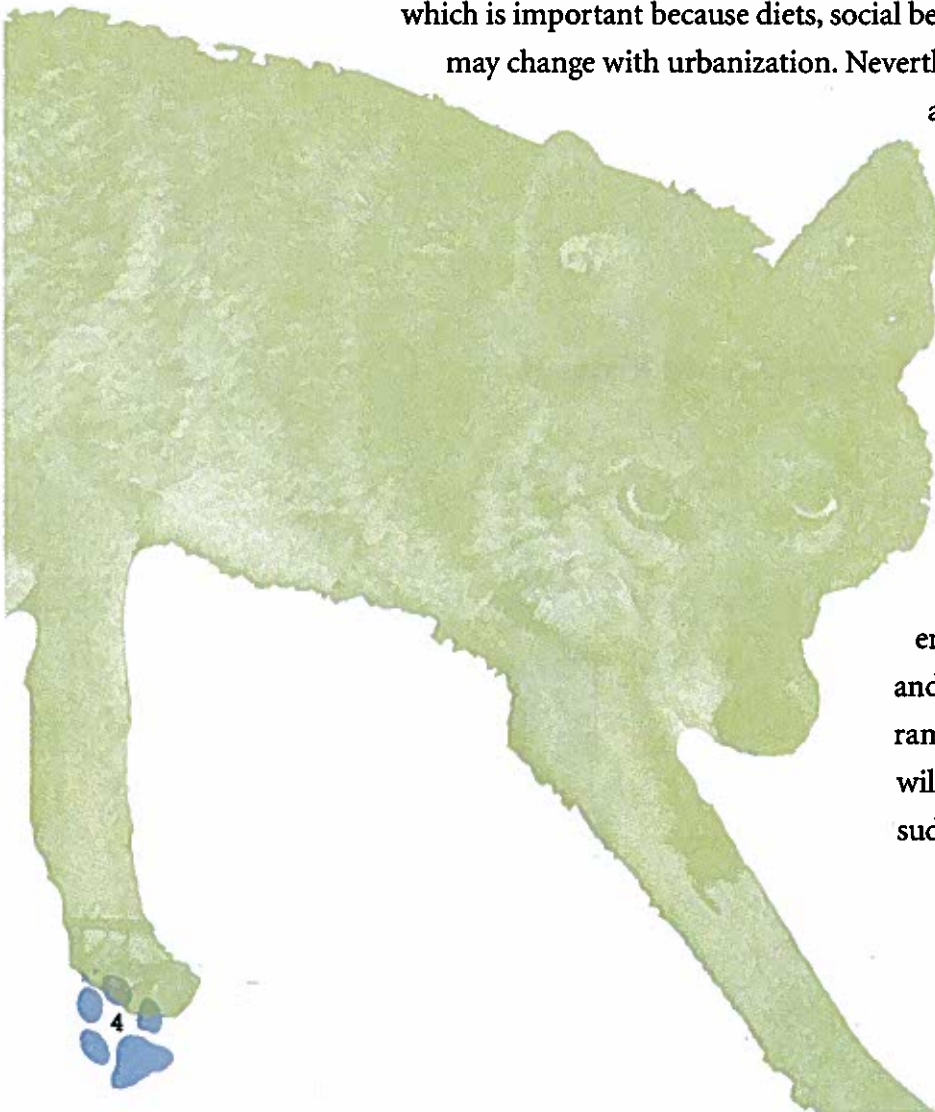


Ghosts of the Cities

Originally known as ghosts of the plains, coyotes have now become ghosts of the cities, occasionally heard but rarely seen. A relatively recent phenomenon, coyotes have become the top carnivores in an increasing number of metropolitan areas across North America, including one of the largest urban centers in the Midwest — the Chicago metropolitan region. However, compared to other urban wildlife, we know very little about how coyotes are becoming successful in landscapes dominated by people.

Our limited understanding of how coyotes succeed in urban landscapes hampers management of this animal. Even knowledge of their basic ecology is incomplete, which is important because diets, social behavior, movement patterns, and survival may change with urbanization. Nevertheless, as coyotes become increasingly abundant in the cities so does the need for basic information from which to develop management strategies.

In areas where coyotes have existed with people for some time, such as the southwestern United States, conflicts with coyotes threaten the health and well-being of people and pets. Are extreme conflicts the inevitable result of the relatively recent emergence of coyotes in Midwestern and eastern U.S. cities? What are the full ramifications for people, pets, and other wildlife when this remarkable canid suddenly becomes a neighbor?



The Cook County, Illinois, Coyote Project

In 2000, we initiated a comprehensive ecological study of coyotes in the Chicago metropolitan area, specifically Cook County, Illinois, to address these shortcomings. The Cook County Coyote Project, largely funded by the Cook County Animal and Rabies Control agency, is a unique study comprised of collaborations between the Max McGraw Wildlife Foundation, the Forest Preserve District of Cook County, the Brookfield Zoo, and the Zoological Pathology Program from the University of Illinois.

As part of this research, we captured coyotes and radio-collared them (Figures 1 and 2). As of February 2006, we had captured 253 individuals and radio-collared 175, making this the largest urban study of coyotes in the world. We tracked the coyotes day and night and located the collared coyotes more than 30,000 times. This allowed us to peek into the hidden lives of urban coyotes. We use results from this unique project to answer common questions regarding coyotes in urban areas.

A large section of this bulletin is dedicated to ecological aspects of coyotes, as we have found that a better understanding of how coyotes “work” is what most of the public wants, and many aspects of coyote ecology have direct management implications. Although our study was focused on Cook County, Illinois, we believe the things we have learned about coyotes and people living together are indicative of many metropolitan areas in the Midwest and eastern United States.

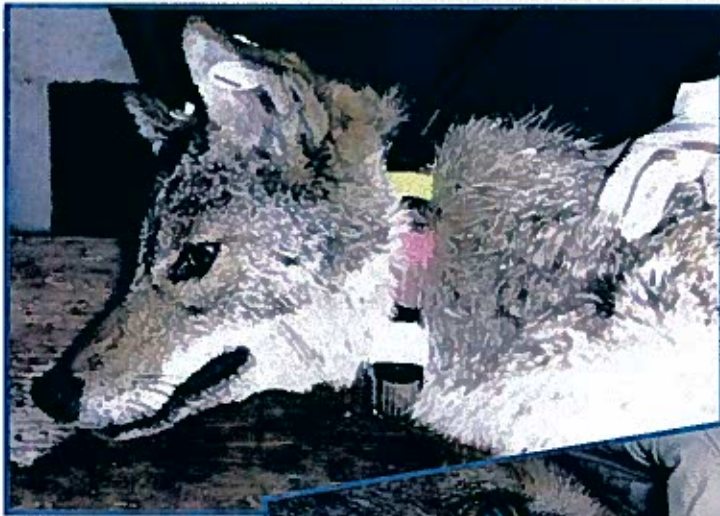
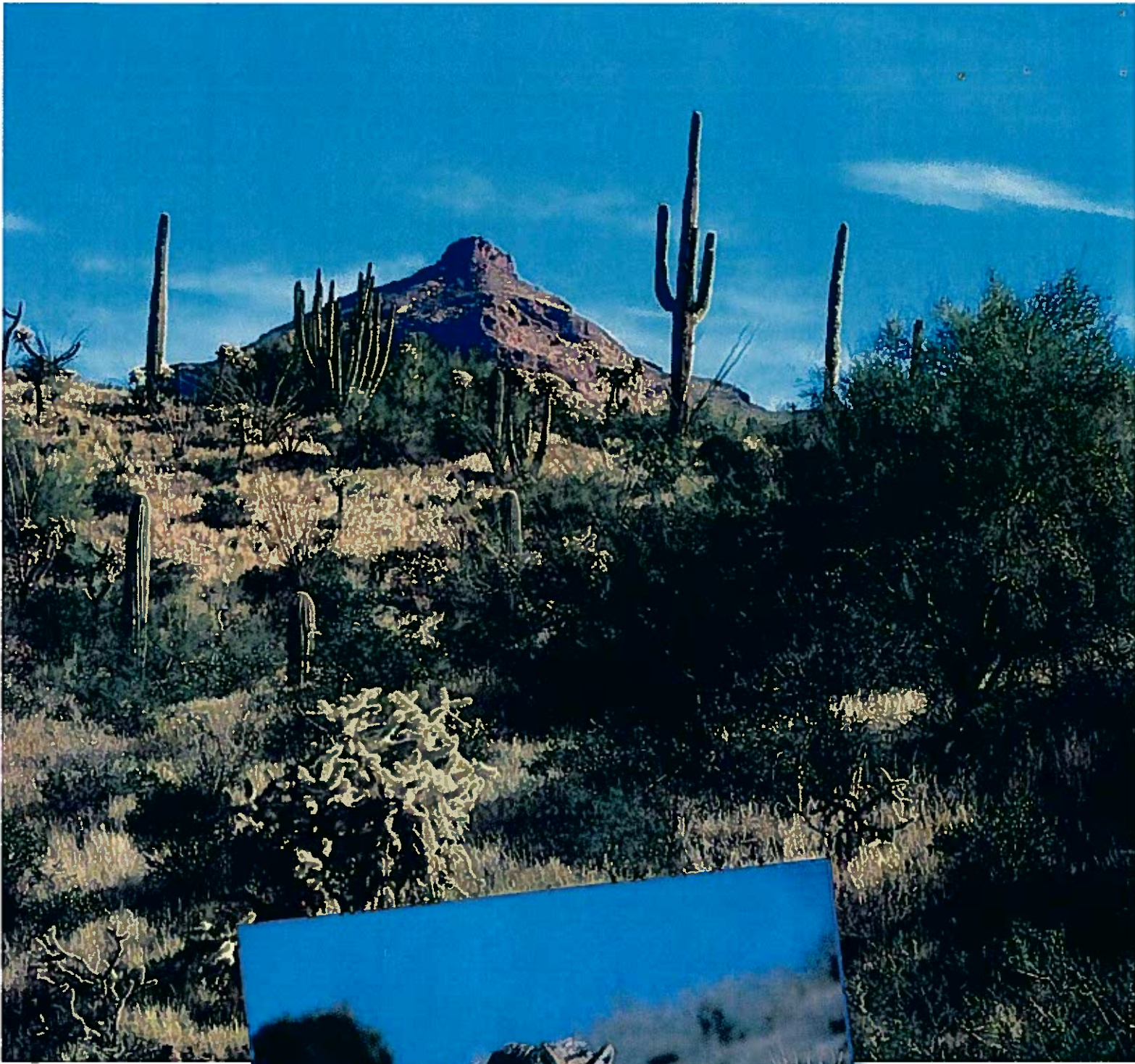


Figure 1. A captured coyote that has just been fitted with a radio-collar and ear tags.



Figure 2. Checking the teeth.

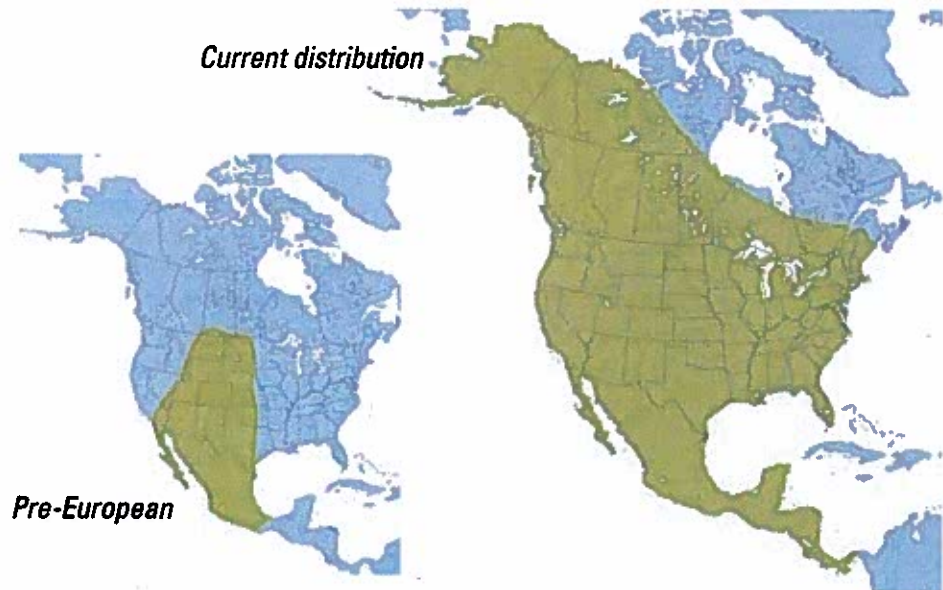


Ecological Characteristics of Urban Coyotes

Where Do Coyotes Come From?

Coyotes are native denizens of the plains and southwestern deserts; they originally came from open grasslands and deserts but have adjusted quickly to other habitats. Many predators, including coyotes, were initially excluded as cities were developed across the Midwest. This pattern is true of the Chicago region, where coyotes were originally native to the area but largely disappeared by the late 19th and early 20th centuries as the area developed into a major metropolitan area. However, during the 20th century, coyotes expanded their range eastward to include all of the eastern United States (Figure 3) and began appearing in large metropolitan areas across their historic and expanded range.

Figure 3. Natives of the plains and deserts, coyotes have expanded their range eastward to include all of the eastern United States.



A dramatic change occurred during the last decade of the 20th century, when interactions between coyotes and people appeared to increase in Cook County. The pattern for the Chicago area is probably typical of many other cities. The number of nuisance coyotes removed annually from the Chicago metropolitan area increased from typically less than 20 coyotes in the early 1990s to more than 350 coyotes each year during the late 1990s (Figure 4). These coyotes were either trapped or shot by wildlife control professionals. The numbers are likely underestimates of the actual number of coyotes removed from the area because some control efforts are not reported. The indication is that coyotes in the Chicago area, and many other metropolitan areas across the Midwest and eastern United States, have increased substantially in urban areas over a short period of time.

Number of coyotes trapped as nuisance animals in the Chicago Region.

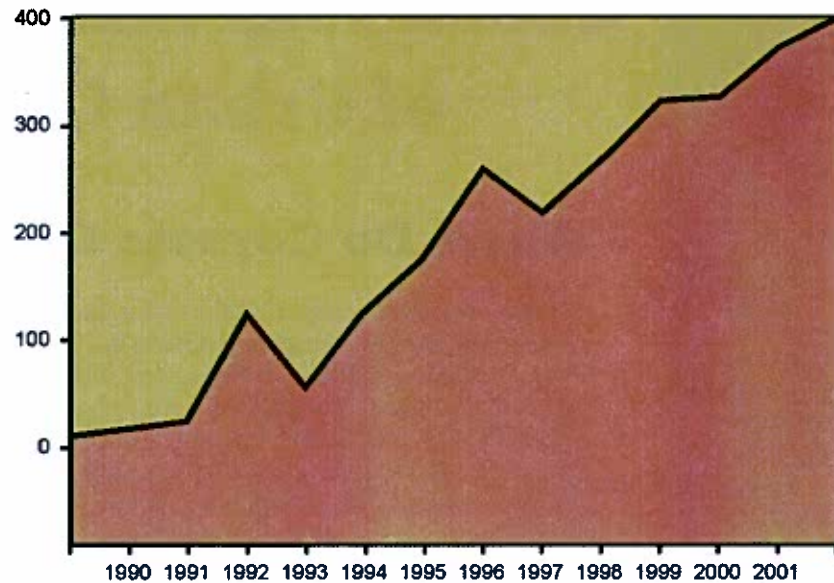


Figure 4. Number of coyotes trapped as nuisance animals in the Chicago region. Courtesy of the Illinois Department of Natural Resources. Used with permission.

Source: Illinois Department of Natural Resources



What Do Coyotes Look Like?

The coyote is a medium-sized member of the dog family that includes wolves and foxes. With its pointed ears, slender muzzle, and drooping bushy tail, the coyote often resembles a German shepherd or collie. Coyotes are usually a grayish brown with reddish tinges behind the ears and around the face (Figure 5), but coloration can vary from a silver-gray to black. The tail usually has a black tip (Figure 6).

Eyes are a striking yellow, with large dark pupils, rather than brown like many dogs. While coyotes are capable of interbreeding with domestic dogs, hybrids (known as coydogs) are generally rare. Most adults weigh between 25 and 35 lbs., although their heavy coats often make them appear larger. There have been suggestions that urban coyotes are larger than rural coyotes, but we have seen no evidence of this.

Figure 5. Profile of a coyote, with long snout and large upright ears.



Figure 6. An adult male coyote, prior to release. Note the black-tipped tail and yellow eyes.

Coyote-Dog Hybrids

People often speculate as to the frequency of coydogs in urban settings. Coyotes and dogs are related, and they are biologically capable of producing hybrid litters. Coydogs have been raised in captivity. Genetic surveys of coyotes have rarely documented evidence of dogs in the genetic makeup of coyotes, despite domestic dogs and coyotes sharing the continent for the past 9,000 years. Although it is possible, coydogs in urban settings are unlikely because:

- ◆ Coyotes are highly seasonal breeders; dogs are not.
- ◆ Coydog females have a shifted estrus cycle that does not coincide with the coyote period.
- ◆ Domestic dog and coydog males do not tend to litters, whereas male coyotes do.
- ◆ Coydogs may have lower fertility than either domestic dogs or coyotes.

How Do I Know If Coyotes Are Present?

Most coyotes are never directly seen by the public, but other clues can be used to determine if coyotes are in the area.

Howling

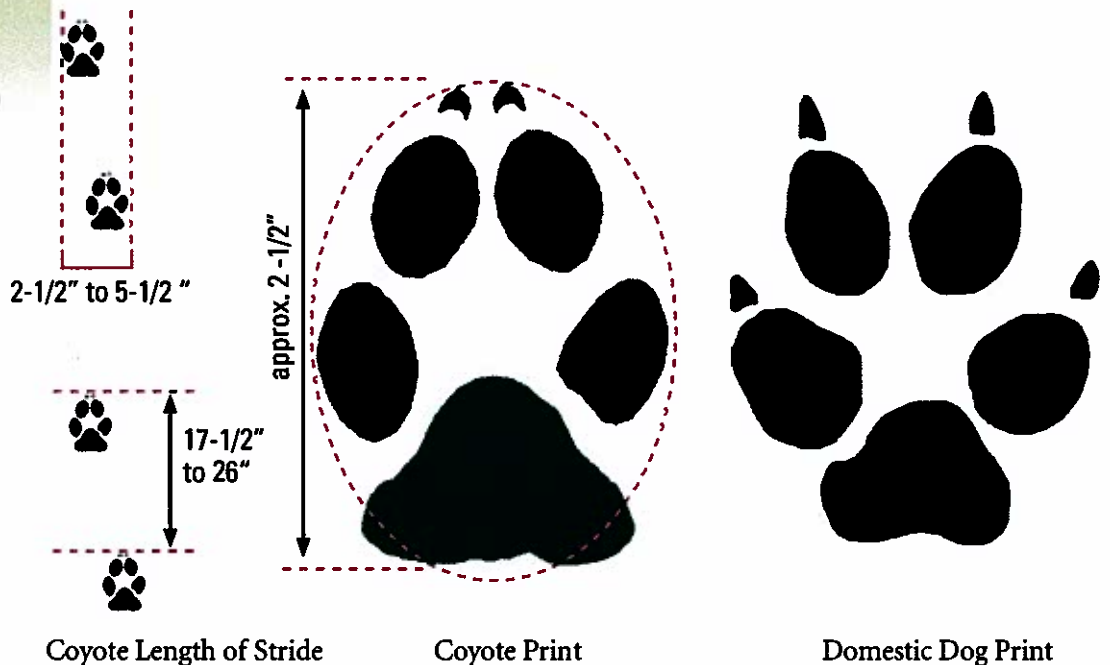
Coyotes emit a range of sounds including howls, barks, and whines. Their howling has resulted in more myth and mystery than perhaps any aspect of their behavior. Indeed, many people consider the howling of coyotes to be the symbol of the West, or at least a vestige of wilderness.

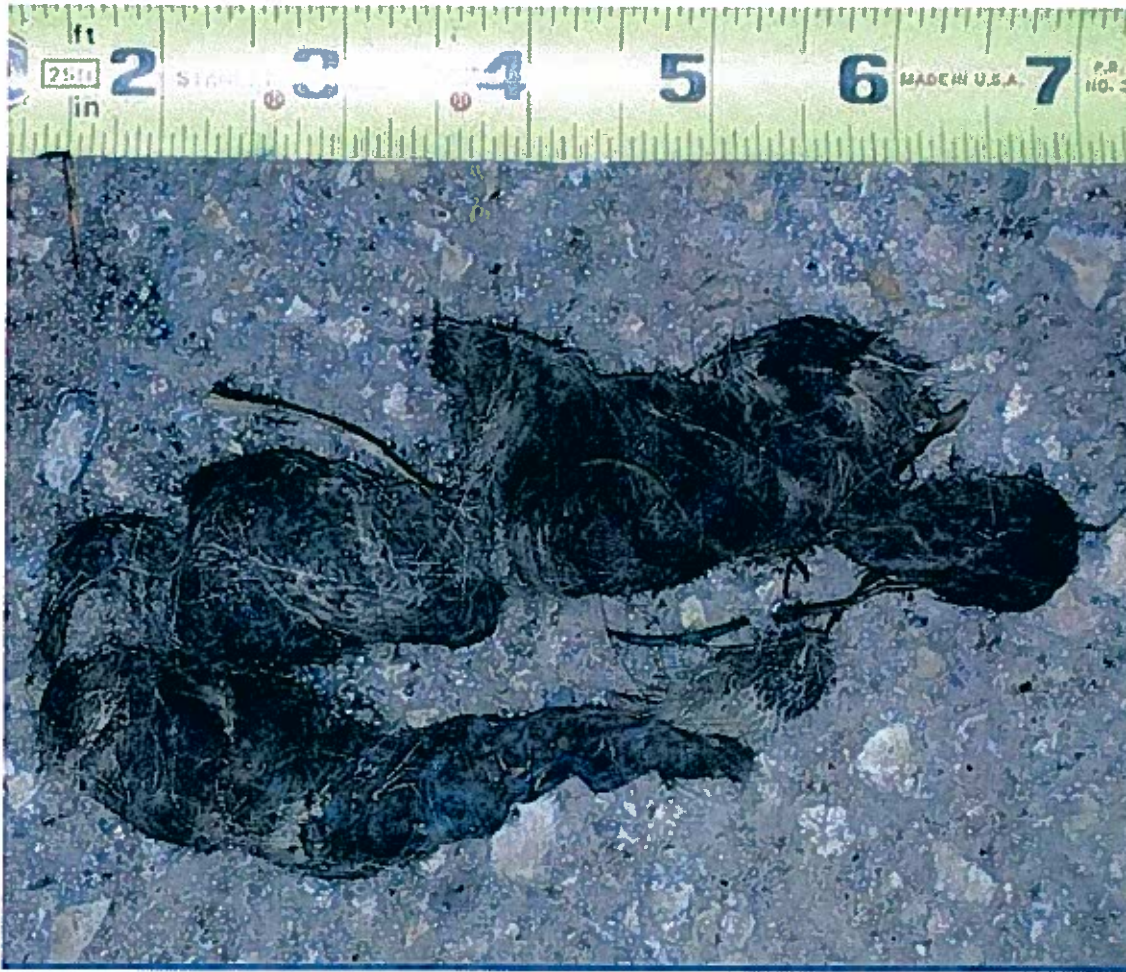
But, do coyotes in urban areas howl? We have observed that some groups howl frequently, whereas other groups rarely howl. One particular coyote group had a territory that included a fire station, and those coyotes regularly howled in response to the sirens of emergency vehicles. Other groups were rarely, if ever, heard howling.

Tracks

The presence of tracks and scat (feces) are often indicators of coyote presence in parks or neighborhoods, but at times these signs can be difficult to distinguish from those of dogs. Coyote prints are quite similar to medium-sized dogs, with four toes and a heel pad in an oval shape, approximately 2.5 inches in length (Figure 7). Often, claw marks are only registered for the middle two toes, and not so much for the outer toes (whereas dogs typically have a circular print with claws for all toes usually registered in prints). Coyotes usually travel in a straight line, whereas dogs shift directions constantly. Anyone who has walked a dog can relate to this.

Figure 7. Comparison of coyote and domestic dog tracks.





Scats

Scats are the feces deposited by coyotes and other wildlife. Coyote scats are rope-like and typically filled with hair and bones, whereas dog scat is soft with dog food. Coyotes use scats for communication and so usually deposit scats in the middle of trails or near the borders of their territories where they are easily seen.

Do Urban Coyotes Form Packs?

Coyotes typically have a highly organized social system, even in urban areas. This consists of packs, or groups of coyotes that apparently defend territories from other coyotes. The conventional wisdom is that coyote packs consist of family members, and the size of these packs can vary greatly across geographic regions and habitat types. Within a family group, only the alpha pair (male and female) will breed, but subordinates may help raise the litter.

Our observations (during tracking, helicopter flights, and trapping) have revealed that the coyotes in our study also maintain territories as groups. Group size in protected habitats is typically five to six adults in addition to pups born that year. Territories do not overlap, so the coyotes obviously defend these areas from other groups. In rural areas, especially where hunting and trapping are common, the group may only consist of the alpha pair and the pups.

Although coyotes live in family groups, they usually travel and hunt alone or in loose pairs. In this way they are different from wolves, which leads to the impression that coyotes do not form packs since they are usually seen alone.

In addition to resident groups, the urban population also consists of solitary coyotes that have left packs and are looking to join groups or create their own territories. Between one-third and one-half of the coyotes we captured each year were solitary animals. These solitary coyotes can be either males or females and are usually young coyotes (six months to two years old) but can also be older individuals who have left packs. If a coyote is seen running across a field, it is impossible to know if it is a solitary coyote or a member of a pack from that sighting.

How Long Do Urban Coyotes Live?

In captivity, coyotes can live 13 to 15 years, but in the wild, most die before they reach three years of age. In our study, we found that coyotes generally have a 60 percent chance of surviving one year. This is higher than most rural studies where coyotes are exposed to hunting and trapping. Nevertheless, most coyotes die before reaching their second year. This is because many pups die from a variety of causes during their first few months outside the den. Survival is fairly consistent among seasons, even during the winter. The oldest coyote in our study in an eight-year-old alpha female (Figure 8).



Figure 8. The oldest coyote in the Cook County Project, she was six years old in this photo and was still monitored as an eight-year-old in 2006.

More than 70 coyotes have died during the six-year study. By far the most frequent cause of death for urban coyotes has been collisions with vehicles (50 to 70 percent of deaths each year) (Figure 9). Other causes of death included shootings, malnutrition, and disease such as sarcoptic mange and parvo virus (four coyotes died from unknown causes) (Figure 10). Mange has been the most common disease-related mortality, and all cases occurred post-2003 (Figure 11).



Figure 9. Road-killed coyote.

Few of the diseases we documented in coyotes are of major importance for people or pets. Mange was the most common disease to affect survival in coyotes. Coyote-strain rabies is restricted to southern Texas, but coyotes are sometimes infected with rabies from other species. If a person is bitten by a coyote that is acting aggressive, he or she should be treated for rabies as a precaution. Anytime a person is bitten by a coyote, animal care and human health professionals should be contacted. Urban coyotes may serve as a reservoir for heart worm; about one-third of the Chicago-area coyotes were infected with the parasite.

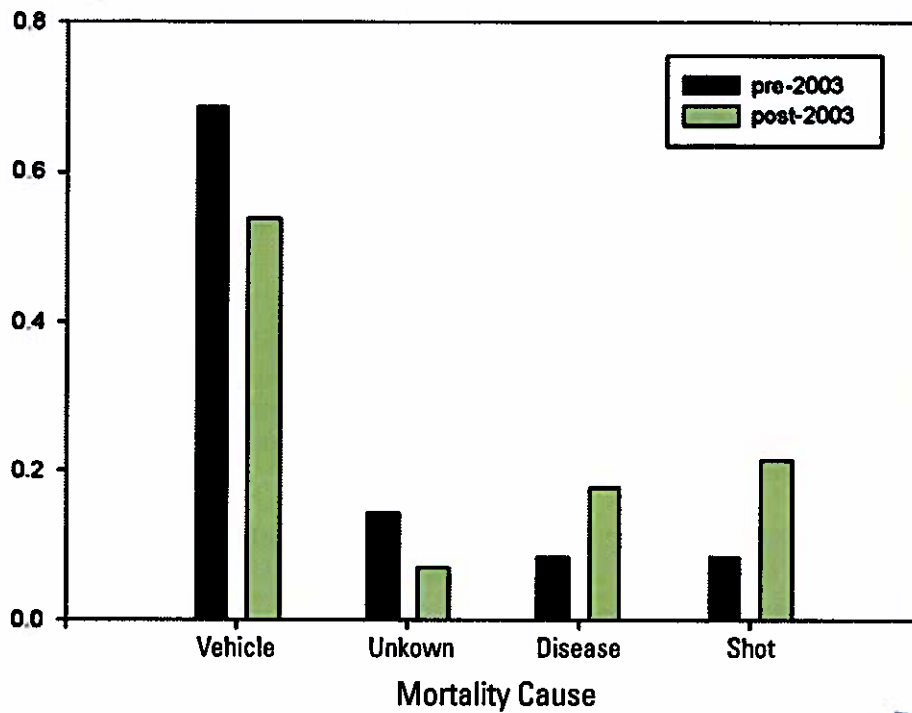


Figure 10. Frequency distribution for causes of mortality for radio-collared coyotes, 2000-2005. Mange occurred during 2004-2005.

Figure 11. Radio-collared coyotes dead from sarcoptic mange.



Mange

There are different types of mange with a range of severity among wildlife species. The type of mange usually associated with coyotes is sarcoptic mange. Some facts:

- ◆ Mange is caused by a very small mite.
- ◆ The mite burrows into the skin and lays eggs.
- ◆ Severe cases of infection will result in hair loss and wounds from scratching.
- ◆ It is transmitted from one animal to another by contact or sharing dens.
- ◆ It can spread to pets, but that rarely happens, especially with coyotes.
- ◆ Mange mites are rarely a problem for humans.

When Do Coyotes Have Young?

In most years, coyotes typically mate in February. Only the alpha pair mates in a pack, but subordinates may help raise the young. In April, after a 62- to 65-day gestation period, the female will begin looking for existing dens or dig one herself. This is the only time coyotes will voluntarily use a den (they usually sleep above ground in the open or in cover).

Figure 12. Coyote den.



It is not uncommon for mothers to move their young from den to den to keep them protected, or to re-use the same den in multiple years. Some coyotes select secluded areas for their dens, whereas others in more urbanized areas have less selection and may use dens near buildings or roads. They usually prefer some protective cover at the den, such as bushes or trees, and some type of slope for drainage (Figure 12).

Litter sizes often range from four to seven pups, depending on food availability and the density of the surrounding coyote population (Figure 14). Some litters can be bigger; the largest litter we have found was 11 pups taken from one den. Coyotes have the ability to adjust their litter sizes based on food abundance and population density. It is difficult for us to get reliable estimates of litter sizes in urban areas, but every indication suggests that litter sizes were larger than average, which indicates an abundant food supply.

Pups stay in the den for about six weeks, and then begin traveling short distances with adults. By the end of summer, pups are spending some time away from parents and attempting to hunt on their own or with siblings.



Figure 13. Young coyote pup.



Figure 14. A litter of pups taken from a den, marked, and then returned.

What Do Urban Coyotes Eat?

Many people believe that urban coyotes primarily eat garbage and pets. Although coyotes are predators, they are also opportunistic and shift their diets to take advantage of the most available prey. A graduate student, Paul Morey, analyzed scat contents at different locations within our study area. He analyzed 1,429 scats and found that diet items varied across space and time, which reflects the flexible food habits of coyotes. The most common food items were small rodents (42 percent), fruit (23 percent), deer (22 percent), and rabbit (18 percent). (Scats often have more than one diet item; therefore, frequencies do not necessarily add up to 100 percent.) Many other items occurred at lower frequencies (Table 1). Voles were the most common small rodent in the diet (Figure 15). Domestic cats were found in only 1.3 percent of scats, and human-related food (garbage, pet food) was found in only 1.9 percent of scats. Apparently the majority of coyotes in our study area do not, in fact, rely on pets or garbage for their diets.

Diet Item	Occurrence
Small rodents	42%
White-tailed deer	22%
Fruit	23%
Eastern cottontail	18%
Bird species	13%
Raccoon	8%
Grass	6%
Invertebrates	4%
Human-associated	2%
Muskrat	1%
Domestic cat	1%
Unknown	1%

* Based on the contents of 1,429 scats collected during 2000-2002. Some scats contained multiple items; therefore, the percentages exceed 100%. See Morey 2004.



Figure 15. A vole, one of the most common diet items for coyotes and a frequent yard and garden pest. Photo courtesy of Cedar Creek Natural History Area, University of Minnesota. Used with permission.



Figure 16. A coyote hunting for rodents under the snow in a commercial park.

Where Are Urban Coyotes Found?

Radio-tracking revealed two different types of movement patterns among coyotes, and these differences were related to social behavior. Members of packs had small territories averaging three square miles (8 km²), whereas solitary coyotes ranged over much larger areas and had home ranges averaging 25 square miles (62 km²). Home ranges are areas used by animals to meet their daily needs and may overlap with home ranges of neighbors; territories are also home ranges except that they are defended from other individuals and do not overlap.

In the case of coyotes, groups (or packs) defend their territories from other groups, whereas solitary coyotes do not defend their home ranges. Other studies have also found that territory sizes of coyotes decrease with increased urbanization given adequate food is available. In general, studies have found that urban coyotes tend to have smaller territories than rural coyotes. Figure 17 illustrates the pattern of pack territories in our study area in 2004, and Figure 18 illustrates the large home ranges of solitary coyotes in relation to the territories in the same year.

Many coyote territories are associated with large parks or forest preserves, which provide an abundance of cover and food. In these cases, the boundaries of territories will often follow the park boundaries (Figure 19). However, much to our surprise, other coyotes have been able to establish territories and form packs without the benefit of large blocks of habitats. This formation of packs and territories can even occur in downtown areas, if parks or natural areas exist in scattered, small patches (Figure 20). In some cases, these are coyotes that have created territories in residential areas or complexes of small parks and golf courses. In either case, coyotes manage to defend these territories so that the territories have very little overlap, which controls their density and spatial arrangement across the landscape. This is frequently called a land-tenure system. We still have much to learn about how coyotes maintain packs in downtown areas.

Approximately 50 percent of the coyotes radio-collared as subadults (one to two years of age) or adults have been solitary for at least a portion of the study. The home ranges of solitary coyotes span large areas of the metropolitan area, and they overlap extensively with pack territories as well as other solitary coyotes. Solitary coyotes use a wide variety of habitats and can be found in virtually any part of the metropolitan area, even in downtown areas. We have observed some solitary coyotes finding mates and establishing their own territories, whereas others eventually disperse and leave the area permanently. In a few cases, resident adult coyotes have left their territories after the death of a mate. Moreover, we have observed individuals change from solitary coyotes with large movement patterns to members of social groups with small territories (and vice versa).

Given the large areas traversed by coyotes and the number of roads coyotes regularly cross during their activities, it is not surprising that vehicles are the most common cause of death. Some of the roads crossed by coyotes in our study have average traffic volumes of more than 100,000 vehicles every 24 hours.



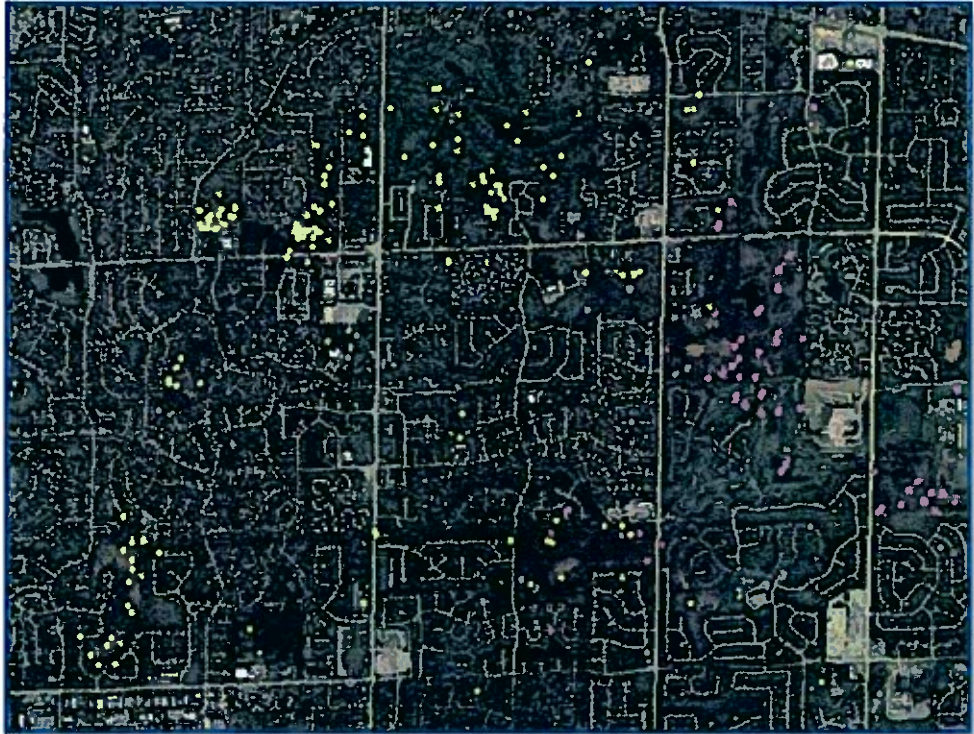
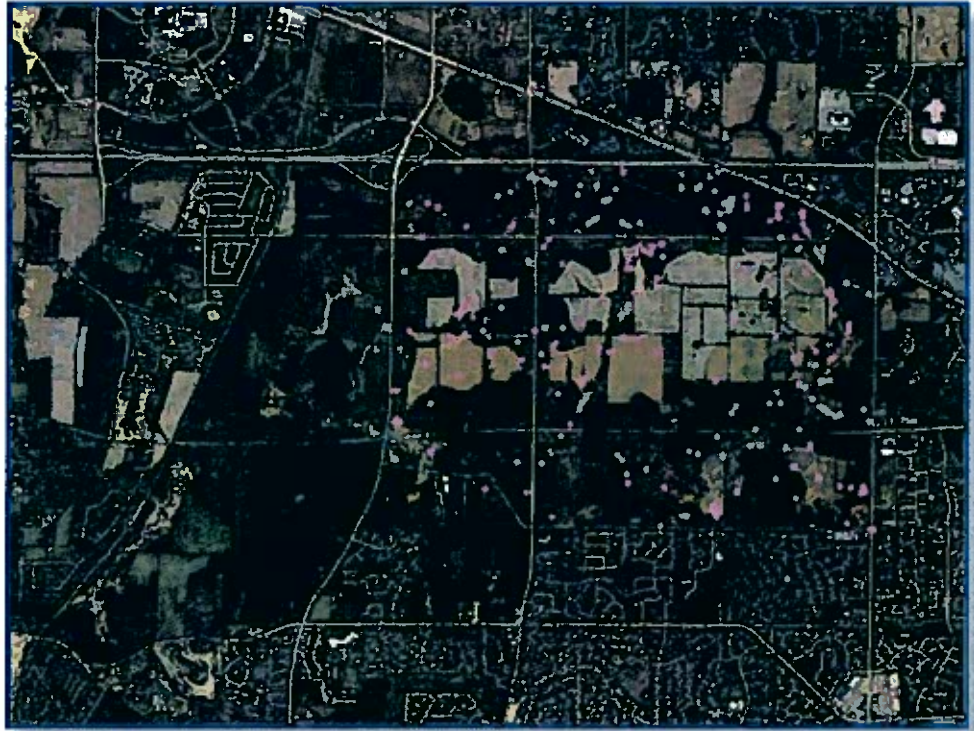
Figure 17. Distribution of coyote packs during 2004. The area of the map encompasses at least 12 cities over 260 square miles. Each color represents the home range of an alpha male or female that represents the territorial boundary for the pack. Some territories are fragmented as a result of the computer model used to estimate the boundaries, but it is obvious that territories have only limited overlap.



Figure 18. Distribution of coyote home ranges during 2004. Light green lines represent the home ranges of solitary coyotes, while the smaller colored areas represent the territorial boundaries of packs (as seen in the previous figure). O'Hare International Airport is located in the lower right corner. The large home ranges of solitary coyotes overlap territories of packs as well as home ranges of other solitary individuals.

Figure 19. Radio-locations of an alpha female coyote associated with the Poplar Creek Forest Preserve during 2000. More than 99 percent of the radio-locations are located within the forest preserve, and the animal (and pack) rarely left the park for three years.

Figure 20. Radio-locations (yellow) of an alpha female coyote with a territory located in a downtown area. Her locations reflect her use of small patches of habitat, but avoidance of residential areas. The purple dots are locations of an adjacent alpha female from another pack.



As the project has progressed, we have been able to follow individual coyotes as they change from solitary coyotes with large movement patterns to social groups with small territories (and vice versa). In some cases, these are coyotes that have created territories in residential areas or complexes of small parks and golf courses.



Figure 21. The alpha female coyote whose downtown territory locations are shown in yellow in Figure 20.

What Good Are Coyotes?

Unfortunately, most of the information the public receives about urban coyotes comes from newspapers or other media that usually focus on conflicts such as pet attacks. However, other aspects of the ecological roles coyotes play in urban areas are poorly understood. Nevertheless, predators, including coyotes, serve important ecological functions, even in metropolitan areas. Here are a few examples of the impacts coyotes have in the Chicago metropolitan area, impacts that some individuals view as beneficial.

Rodents

As we have seen, rodents make up the bulk of the coyote diet in both urban areas and rural areas. Although it has yet to be measured in urban systems, experiments in rural areas have shown that the removal of coyotes results in a dramatic increase in rodent abundance and a decrease in rodent diversity (this means that only a few species increase and exclude other rodent species). We have observed rodent increases in areas such as golf courses following coyote removal programs. There is also the possibility that coyotes help to control woodchucks. Many areas, such as cemeteries and golf courses, have reported declines in woodchuck abundance once coyotes appeared.

White-Tailed Deer

Deer are often overabundant and difficult to manage in urban areas. Although coyotes rarely take adult deer, they are primary predators of deer fawns. Colleagues from the Illinois Natural History Survey conducted a fawn survival study in different locations within the Chicago area and found that coyotes killed 20 percent to 80 percent of the fawns in different populations. Coyotes cannot reduce deer populations because they do not often take adult deer (in the Midwest), but they may slow population growth in high-density areas through their predation on fawns.

Canada Geese

Geese have adapted to urban landscapes much like deer and at times become overabundant and a nuisance. Geese can also be a challenge to manage in urban areas. A study of geese in the Chicago area found that the population was growing much less rapidly than predicted, and that population growth was limited by nest predation. By placing modified video cameras at the nests, we were able to identify coyotes as the major predator on the nests (Figure 22). Thus, coyotes are serving as a biocontrol for urban geese. Because egg contents are not detected in coyote scat, the extent of coyote predation on goose nests could only be determined by placing cameras at nests. As with deer, coyotes do not take enough adult geese to reduce the population, but they can slow the population increase through egg predation.



Figure 22. Remote photo of a coyote taking a goose egg from a nest. Coyotes usually flush geese off nests and take eggs to eat or cache in holes.

Domestic Cat

This is perhaps one of the most controversial aspects to the urbanization of coyotes and often pits sections of the public against each other. Coyotes kill cats for food or to remove potential competitors. Those members of the public who own cats or are otherwise interested in their well-being view this function of coyotes as strongly negative. However, a positive consequence of coyotes removing peri-domestic or feral cats is the trickle-down effect. Studies in California urban areas showed that coyotes reduced cats in some habitat fragments, which then resulted in an increase in nesting success for songbirds. Thus, the coyote serves as a top predator by removing an important smaller predator, the cat, with birds and perhaps other species subsequently increasing in number. More research is needed to determine if these trickle-down effects also occur in other metropolitan areas.

What Effect Do Coyotes Have on Other Wildlife?

There has been a recent flurry of studies addressing the relationships between coyotes and other medium-sized predators such as raccoons, skunks, and foxes. In some cases, these relationships are fairly clear, but for others, there is only speculation.

In rural areas, coyotes often kill red foxes and limit their populations. We know less about this relationship in large, metropolitan areas. We did not specifically measure fox populations during the 1990s in the Chicago area when the coyote population appeared to increase, but we have conducted recent surveys that indicate both species have declined. This supports the general impressions of most nature center and park personnel in the area.

Some research has suggested that coyotes may limit medium-sized predators that are smaller than coyotes, including raccoons, striped skunks, and opossums. Although this perception has become quite popular, we have found little evidence that coyotes limit raccoons or skunks in urban areas. In fact, we have explored these relationships in some detail and it appears that coyotes have little impact on mesopredator populations outside of foxes and domestic cats, although we have not tested the possible impact of coyotes on opossums.

These are a few examples of the impact coyotes may have in urban areas, some of which might be considered positive effects. This is by no means a thorough list, and as we learn more about the ecological relationships between coyotes and other wildlife, the list of examples will increase.



Conflicts Between Coyotes and Humans

For many reasons, the popular media focuses on conflicts between coyotes and people within cities. Even so, most incidents are difficult for the public to interpret and place into the proper perspective. Most people have little idea as to what the appropriate response is to coyote incidents, and inappropriate responses can exacerbate the situation.

Coyote conflicts can range from relatively benign sightings of the occasional animal without additional incidents, to pet killings, to the most extreme cases of coyotes attacking people. Coyotes differ from most other wildlife species in cities in that they can be considered a nuisance without any evidence of damage, but simply by being seen. Perhaps because of their role as a large predator, people are sensitive to the real or perceived threat to pets or children. Indeed, most complaints regarding coyotes are that they occur near people, regardless of whether any damage has occurred.

More extreme are the cases where coyotes attack and, sometimes, kill pets. As coyotes move into metropolitan areas, there is undoubtedly an increase in the loss of free-ranging domestic cats (Figure 23). Coyotes sometimes take cats as food, or simply to remove a possible competing predator from their territory (much like they do with foxes). Less commonly, they may attack small dogs or, even less frequently, medium-to-large dogs.

Usually dogs are attacked when they are not accompanied by people, but in some rare cases, small dogs have been taken in the presence of an owner. Small dogs may be taken at any time of year, but attacks on larger dogs are usually associated with the mating or breeding season, when coyotes are most territorial. In some cases, small dogs have been taken while the dog was on a lead, or coyotes have jumped fences to attack a dog in a yard. Most metropolitan areas in the Midwest and eastern United States have reported an apparent increase in the number of attacks on pets.



Figure 23. Outdoor domestic cats are often taken by coyotes.

Most extreme, and relatively rare, are cases where coyotes attack people. The majority of cases involve younger children. Most attacks have occurred in the Southwest, especially southern California, where coyotes have lived in suburbs for decades. The only fatal case of a coyote attack in recent history occurred in 1981 in a Los Angeles suburb. In Midwestern metropolitan areas where coyotes are a relatively recent phenomenon, coyote attacks on people are still isolated and rare.

Are All Coyotes a Threat to People?

We were surprised to find so many coyotes living near people in Cook County, and yet relatively few conflicts have been reported. We assumed that with an average of 350 coyotes removed each year from the area as nuisances, most urban coyotes would create problems. In contrast, only five of 175 radio-collared coyotes have been removed as nuisances (as defined by the local community). Apparently, few coyotes have become nuisances in Cook County, and it is likely that this is true of other metropolitan areas. It remains to be seen if conflicts will remain relatively rare or if they become more common as coyotes adjust to living with humans.

For perspective, it is worth considering that no documented case of a coyote biting a human has been reported for Cook County. Contrast that result with domestic dogs, in which Cook County often records 2,000 to 3,000 dog bites each year (including some fatalities). In 2005, there were no recorded bites on people by coyotes in Cook County, but 3,043 bites were recorded for domestic dogs (data from Cook County Animal and Rabies Control).

What Creates Nuisance Coyotes?

Those coyotes that became nuisances during our study typically became habituated through feeding by people. In other words, people were feeding wildlife and either intentionally, or unintentionally, fed coyotes. Once coyotes associated human buildings or yards with food, they increased daytime activities and thus were seen more easily by people.

In those areas in southern California where attacks have been more common, researchers have reported a higher frequency of human-related food in the diet of nuisance coyotes. This was indicative of feeding by people, or coyotes seeking food in garbage. In either case, it is becoming apparent that feeding of coyotes should be discouraged. A common pattern for many human attacks has been feeding prior to the incident — in many cases intentional feeding.

What Are Some Steps to Avoid Conflicts With Coyotes?

Conflicts with coyotes can be avoided by taking simple precautions or by altering behaviors to avoid confrontation.

1. Do not feed the coyotes.

Intentional feeding, such as bait stations in yards or parks, should be avoided. However, many people unintentionally feed coyotes by leaving pet food or garbage out at night or having large bird feeders (Figure 24 on page 26). Coyotes are usually not interested in bird food, but bird feeders often attract rodents, especially squirrels, which then attract coyotes. Although coyotes seem to have a natural inclination to avoid human-related food, this can change when prey populations are low, or if the coyotes are young and haven't yet learned to hunt effectively.

2. Do not let pets run loose.

If coyotes live nearby, do not let pets run loose, especially domestic cats. When hiking in urban parks, keep dogs on leashes.

3. Do not run from a coyote.

When you encounter a coyote, shout or throw something in its direction.

4. Repellents or fencing may help.

Some repellents may work in keeping coyotes out of small areas such as yards, although these have not been tested thoroughly for coyotes. Repellents may involve remotely activated lights or sound-making devices. Fencing may keep coyotes out of a yard, particularly if it is more than 4 feet in height with a roll bar across the top.

5. Report aggressive, fearless coyotes immediately.

When a coyote fails to exhibit fear of humans or acts aggressively by barking or growling in the yard or playground, the animal must be reported as soon as possible to the appropriate officials — usually an animal control officer or police officer.

When Should I Be Concerned?

A list of signs indicating an increase in threats from coyotes is presented here. However, it is important to note that coyotes are highly variable in their behavior, and this sequence may not always be predictive:

1. Coyotes are rarely or occasionally seen at night, more rarely during dusk and dawn. Occasional howling.

Response: Education; prohibit/limit feeding of wildlife.

2. Coyotes are occasionally seen during the day, frequently seen at night, an occasional house cat disappears.

Response: Education; prohibit/limit feeding of wildlife; free-ranging pets are at risk; use negative stimuli for coyotes — shouting, chasing, throwing objects.

3. Coyotes are frequently seen during the day, appearing in yards on an increasing basis, but they flee when approached by people. Pets in yards are attacked.

Response: Education; prohibit/limit feeding of wildlife; supervise pets; consider a removal program; use negative stimuli for coyotes — shouting, chasing, throwing objects.

4. Coyotes taking pets from yards, approaching people without fear, acting aggressive (growling, barking) when subjected to negative stimuli, following children.

Response: Initiate removal program in conjunction with education; prohibit/limit feeding of wildlife; supervise pets; use negative stimuli.

Management Options

Human Behavior

Figure 24. A coyote approaching bird feeders in a resident's backyard during the afternoon. This coyote became habituated through wildlife feeding at another location but then became attracted to squirrels and other rodents located near the bird feeders.

Management programs for urban coyotes should begin with public education and untangling facts from myths. People should become aware of coyote sign and understand the differences between true threats and coexistence. It is important to stress that our relationship with coyotes is directly affected by our behavior — coyotes react to us, and we can foster mutual respect or a lack of respect through cues we send to coyotes. Some people are enamored with coyotes. They like seeing them near their yards and attempt to entice them by baiting them, or they want to try to “tame” them. Intentional feeding such as this should be prohibited, otherwise other management solutions will be temporary at best.

People should be discouraged from inadvertent feeding where coyotes are present. This includes leaving pet food outside at night and maintaining large bird feeders that attract multiple species of wildlife.



Where coyotes are more obvious, pets should be supervised. There is little that can be done for free-ranging domestic cats other than keeping the cats inside or removing coyotes.



Figure 25. A radio-collared coyote scared from a nest by a flash camera. Equipment using flashes or sounds may be effective at scaring coyotes from small areas.

Negative Stimuli

People should be encouraged to act aggressively toward coyotes during encounters, to re-instill a fear of humans in coyotes. In many cases, this involves shouting, waving, or clapping hands, and looking as tall as possible. Residents in some communities will chase coyotes by banging pots and pans, or throwing balls or rocks at them. However, this should be done within reason so as not to create conflicts that might not otherwise occur by injuring or cornering a coyote that simply wants to escape.

Relatively small properties that have coyote visitors may be able to use scare devices for coyotes, such as electronic sirens and lights, although these have not yet been tested thoroughly. We have successfully used game cameras with flashes to repel coyotes from yards (Figure 25), but these may not work in every circumstance.

Removal

There are instances where coyote habituation is so severe that the coyotes can be considered an immediate threat to people, especially children and pets. This is when removal is often warranted. Lethal removal is accomplished either through trapping/euthanasia or shooting. Coyotes are difficult to trap or shoot, and these actions should be undertaken by professionals, especially in urban areas. Removal efforts should observe state and municipal codes. Fortunately, because of habituation, nuisance coyotes are often easier to capture than non-habituated individuals.

Removal programs designed to target specific nuisance coyotes will be more successful than broad removal programs that have a goal of removing a complete population of coyotes. It is difficult to capture all coyotes residing in an area, and as coyotes are removed, they are replaced by solitary ones.

Removal, especially lethal removal, is often controversial within communities. This is especially true when the perceived threat by coyotes is somewhat ambiguous to residents. Removal programs can also be expensive, either for residents or municipalities, and traps can occasionally capture pets. For these reasons, as well as ethical reasons, coyote removal is best employed only after education has been attempted or if there is an immediate, and obvious, threat to human safety.

Relocation

One option often used as a compromise is to remove coyotes with trapping and then relocate them to a distant site. Although the primary objectives of the Cook County Coyote Project did not involve relocating coyotes, as a service we did monitor 12 relocated nuisance (or rehabilitated) coyotes from the city of Chicago to document their movements and fates. We found that no relocated coyotes remained at their release site despite being located in favorable coyote habitat (usually they were gone within 48 hours or less), and each of them traveled in the general direction of their origin. No coyotes made successful returns, and many were killed by cars or hunters as they left the release site.

Relocation rarely is effective for any species and particularly so for coyotes. However, many removal programs still relocate coyotes with the understanding that it will likely result in the death of that individual because relocation is more palatable to the general public than euthanasia.

The Future

A major finding from our research is the extent to which coyotes and people are living together; we captured more coyotes and observed more use of developed areas by coyotes than we expected. People are often unknowingly in close contact with coyotes each day, and in the vast majority of cases, the coyotes are still serving as ghosts of the cities, much as they did on the plains. But coyotes are watching and learning from us; we influence their behavior, and it will be our actions that determine what the future holds for our new neighbors.

Implications from the Cook County Coyote Project

- ◆ Coyotes are common throughout most of the Chicago region, and our radio-tracking data demonstrate that people and coyotes coexist on a daily basis, with people usually unaware of interactions.
- ◆ As a top predator, coyotes are performing an important role in the Chicago region. Increasing evidence indicates that coyotes assist with controlling deer and Canada goose populations.
- ◆ Most coyotes are feeding on typical prey items, such as rodents and rabbits, and generally avoid trash. However, wildlife feeding will eventually habituate some coyotes, leading to conflicts.
- ◆ Coyotes are exposed to a wide range of diseases; however, to date none of them pose a serious human health risk. In general, the coyote population appears to be relatively healthy.
- ◆ Effective control programs target nuisance coyotes, rather than targeting the general coyote population. Coyotes removed through control efforts or other causes are quickly replaced. Successful management programs also include public education and outside consulting.
- ◆ Some types of repellents, such as electronic devices employing lights and sound, may be useful for preventive control of coyotes, but more work is needed to evaluate their effectiveness.



Selected Bibliography

Urban Ecology of Coyotes

Atkinson, K. T., and D. M. Shackleton. 1991. Coyote, *Canis latrans*, ecology in a rural-urban environment. *Canadian Field-Naturalist* 105:49-54.

Atwood, T. C., and H. P. Weeks Jr. 2003. Spatial home-range overlap and temporal interaction in eastern coyotes: the influence of pair types and fragmentation. *Canadian Journal of Zoology* 81: 1589-1597.

Atwood, T. C., H. P. Weeks, and T. M. Gehring. 2004. Spatial ecology of coyotes along a suburban-to-rural gradient. *Journal of Wildlife Management* 68: 1000-1009.

Crooks, K. R. 2002. Relative Sensitivities of Mammalian Carnivores to Habitat Fragmentation. *Conservation Biology* 16:488-502.

Fedriani, J. M., T. K. Fuller, and R. M. Sauvajot. 2001. Does availability of anthropogenic food enhance densities of omnivorous mammals? An example with coyotes in southern California. *Ecography* 24: 325-331.

Gibeau, M. L. 1998. Use of urban habitats by coyotes in the vicinity of Banff, Alberta. *Urban Ecosystems* 2: 129 – 139.

Gosselink, T. E., T. R. Van Deelen, R. E. Warner, and M. G. Joselyn. 2003. Temporal habitat partitioning and spatial use of coyotes and red foxes in east central Illinois. *Journal of Wildlife Management* 67: 90-103.

Grinder, M., and P. R. Krausman. 2001. Morbidity-mortality factors and survival of an urban coyote population in Arizona. *Journal of Wildlife Diseases* 37: 312-317.

Grinder, M., and P. R. Krausman. 2001. Home range, habitat use, and nocturnal activity of coyotes in an urban environment. *Journal of Wildlife Management* 65: 887-898.

McClennen, N., R. R. Wigglesworth, S. H. Anderson, and D. G. Wachob. 2001. The Effect of Suburban and Agricultural Development on the Activity Patterns of Coyotes (*Canis latrans*). *The American Midland Naturalist* 146: 27-36.

Morey, P. S. 2004. Landscape use and diet of coyotes, *Canis latrans*, in the Chicago Metropolitan Area. M.S. Thesis, Utah State University, Logan. 119 pp.

Quinn, T. 1995. Using public sighting information to investigate coyote use of urban habitat. *Journal of Wildlife Management* 59: 238-245.

Quinn, T. 1997. Coyote (*Canis latrans*) habitat selection in urban areas of western Washington via analysis of routine movements. *Northwest Science* 71: 289-297.

Quinn, T. 1997. Coyote (*Canis latrans*) food habits in three urban habitat types of western Washington. *Northwest Science* 71: 1-5.

Riley, S. P. D., R. M. Sauvajot, T. K. Fuller, E. C. York, D. E. Kamradt, C. Bromley, and R. K. Wayne. 2003. Effects of urbanization and habitat fragmentation on bobcats and coyotes in southern California. *Conservation Biology* 17: 566-576.

Tigas, L. A., D. H. Van Vuren, and R. M. Sauvajot. 2002. Behavioral responses of bobcats and coyotes to habitat fragmentation and corridors in an urban environment. *Biological Conservation* 108:299-306.

Way, J. G. 2003. Description and possible reasons for an abnormally large group size of adult eastern coyotes observed during summer. *Northeastern Naturalist* 10: 335-342.

Way, J. G., I. M. Ortega, and E. G. Strauss. 2004. Movement and Activity Patterns of Eastern Coyotes in a Coastal, Suburban Environment. *Northeastern Naturalist* 11: 237-254.

Coyote Conflicts in Urban Areas

Baker, R. O., and R. M. Timm. 1998. Management of conflicts between urban coyotes and humans in southern California. Pp. 299-312 in R. O. Baker and A. C. Crabb, Eds., *Proceedings, 18th Vertebrate Pest Conference, University of California-Davis*.

Bounds, D. L., and W. W. Shaw. 1994. Managing coyotes in U.S. national parks: human-coyote interactions. *Natural Areas Journal* 14:280-284.

Carbyn, L. N. 1989. Coyote attacks on children in western North America. *Wildlife Society Bulletin* 17:444-446.

Howell, R. G. 1982. The urban coyote problem in Los Angeles County. Pp. 21-23 in R. E. Marsh, Ed., *Proceedings, 10th Vertebrate Pest Conference, University of California-Davis*.

Timm, R. M., R. O. Baker, J. R. Bennett, and C. C. Coolahan. 2004. Coyote attacks: an increasing suburban problem. *Transactions of the North American Wildlife and Natural Resources Conference* 69:67-88.

Coyote-Dog Hybrids

Adams, J. R., J. A. Leonard, and L. P. Waits. 2003. Widespread occurrence of a domestic dog mitochondrial DNA haplotype in southeastern U.S. coyotes. *Molecular Ecology* 12:541-546.

Cook, R. 1952. The coy-dog: hybrid with a future? *Journal of Heredity* 43:71-73.

Dice, L. R. 1942. A family of dog-coyote hybrids. *Journal of Mammalogy* 23:186-192.

Kennelly, J. J., and J. D. Roberts. 1969. Fertility of coyote-dog hybrids. *Journal of Mammalogy* 50:830-831.

Mengel, R. M. 1971. A study of dog-coyote hybrids and implications concerning hybridization in *canis*. *Journal of Mammalogy* 52:316-336.



Urban Coyote Ecology and Management
The Cook County, Illinois, Coyote Project

