

Heinrich, B. 1999. *Mind of the Raven: Investigations and Adventures with Wolf-Birds*. New York: HarperCollins.

Kilham, L. 1989 *The American Crow and the Common Raven*. College Station: Texas A&M University Press.

**Bernd Heinrich**

## ■ Coyotes

### ***Clever Tricksters, Protean Predators***

“Old man coyote” is an amazing and adaptable being. Coyotes are true survivors, chiefly because of their adaptable ways. William Bright, in his collection of stories titled *A Coyote Reader*, notes: “Coyote is the trickster par excellence for the largest number of American Indian cultures.” Native peoples have portrayed coyotes as a sly tricksters, thieves, gluttons, outlaws, and spoilers because of their uncanny ability to survive and to reproduce successfully in a wide variety of habitats and under harsh conditions. The cartoon character, “Wile E. Coyote,” exemplifies these features. Coyotes generally survive not only their encounters with other nonhuman predators (though they are losing out to gray wolves in some parts of Yellowstone National Park, but not in others), but also with humans who attempt to control them using brutal methods, and who also hold well-organized community hunts in which the person who kills the most coyotes wins a prize.

Coyotes belong to the dog family (Canidae). They are closely related to wolves, domestic dogs, jackals, dingos, dholes, and foxes. Coyotes originally inhabited open plains and grasslands in North America. Due to intense control and management and the absence of such competitors as wolves, coyotes now thrive in habitats ranging from dry, warm deserts, to wet grasslands and plains, to forests, to colder climates at high elevations (up to about 10,000 feet or 3,200 meters). Coyotes can be found between northern Alaska and Costa Rica and throughout mainland United States and Canada. They also live in large urban cities such as Los Angeles, California, and New York City. A coyote once tried to enter an elevator in an office building in Seattle, Washington!

Coyotes are genuine masters of behavioral flexibility. I have studied coyotes for more than 25 years and my research along with that of my colleagues has shown that talking about “the” coyote is misleading. The moment one begins making rampant generalizations, they are proven wrong. Coyotes show great variation in their social organization. In some areas coyotes live like typical gray wolves, in resident packs of 4–8 individuals that are closely-knit extended families consisting of overlapping generations of parents, young-of-the-year, and adult helpers who do not reproduce but could if they left the group. In other habitats they live either as mated pairs or as roaming single individuals, showing little or no attachment to a particular site. During



***A coyote sits in an urban parking lot.***

© Glenn Oliver / Visuals Unlimited.

our 8-year study of coyotes living around Blacktail Butte in the Grand Teton National Park just outside of Jackson, Wyoming, we discovered that coyotes living as few as 1.5 km (1 m) apart showed variations in social organization.

Packs typically exist when there is enough food to allow some young-of-the-year to remain with their parents and older siblings, rather than to go out or to disperse on their own. Pack formation in coyotes appears to be an adaptation for the defense of food and territory rather than for the acquisition of live prey. Coyotes, unlike wolves, only rarely actively try to capture large prey such as deer or elk. Furthermore, coyotes are sometimes territorial and sometimes they do not defend territorial borders.

Male and female coyotes form dominance hierarchies. Sometimes dominance relationships among littermates persist for more than a year. Coyotes are usually monogamous. Pair bonds between the same male and female can last upwards of 4 years. In packs, usually only the dominant male and dominant female mate each year. Coyotes breed once a year, in early-to mid-winter depending on locale. Courtship lasts 2 to 3 months. The gestation period averages 63 days and average litter size is 6 pups with an even sex ratio (same number of females and males) at birth. Pups are born blind and helpless, usually in an excavated den, and emerge from the den at about 2–3 weeks of age. Pups are weaned at about 5–7 weeks of age, at which time they begin to eat meat provided by parents and other adults. Parents often receive help from other group members in rearing young and in defending food and territory borders both within and outside of the breeding season. Some helpers go on to inherit the territory in which they were born (called the *natal area*), breed, and receive help from individuals to whom they previously provided care, whereas others strike out on their own and attempt to find a mate. During our study of coyotes living in the Grand Teton National Park, my students and I discovered that it took more than two coyotes to successfully defend a territory from intruding coyotes, and that single coyotes were significantly less successful in doing so. Pack members working together were successful in driving off intruders 75% of the time, whereas single individuals had a 33% success rate. Thus, there are benefits to living in a group that is larger than just the parents and their young offspring who do not help in territorial defense. Coyotes can live as long as 18 years in captivity, but in the wild few live longer than about 6–10 years. Coyotes can produce fertile hybrids when they mate with gray wolves, red wolves, and domestic dogs.

In addition to showing great behavioral flexibility, coyotes also enjoy a highly varied diet including plant and animal matter and inanimate objects such as boots and gloves. They have been observed to fish and to climb trees in pursuit of food. Coyotes are also successful scavengers. Diet varies seasonally and in different regions. Coyotes rely primarily on vision while hunting. They typically hunt small rodents (mice and squirrels) alone and do not regularly group hunt large ungulates such as deer and elk.

Coyotes also show variations in home range and territory size. Individual coyote ranges can be as large as 50–70 km<sup>2</sup> (19–27 mi<sup>2</sup>). Home range area is affected by the presence of other coyotes and competitors and the amount of population control to which individuals are subjected. The distribution of food also influences territory and home range size. When food is abundant in small areas, coyotes tend to spend most of their time in that place.

Coyotes communicate using many different olfactory (odor), vocal (11 different sounds), and visual (different facial expressions, gaits, postures, and tail positions) signals. Males often deposit urine to scent mark territorial boundaries. Female urine attracts males when they are ready to mate. Coyotes are considered to be the most vocal of North American wild mammals. The scientific name of coyotes, *Canis latrans*, means “barking dog.” Coyotes growl, huff, bark, bark–howl, whine, yelp, and howl. Group yip–howling occurs

following a reunion or during greeting. Group howling and lone howling are used as contact calls to announce location when individuals are separated from group members. Coyotes bark when they are alarmed or when they threaten others.

In a nutshell, coyotes are quintessential and resourceful opportunists who defy profiling as individuals who predictably behave this way or that. Because of their slyness and behavioral flexibility, they are fascinating and challenging to study.

Coyotes are also a very important part of the ecological web in various communities because they help to regulate species at different trophic levels. The biologists Kevin Crooks and Michael Soulé studied the complex interrelationships among coyotes, other medium-sized predators (*mesopredators*) such as domestic cats, opossum, and raccoons, and scrub birds including California quail, wren tits, Bewick's wrens, greater roadrunners, and cactus wrens living near San Diego, California. Their research is an excellent example of the importance of long-term projects that investigate complex webs of nature that are not obvious at first glance. Crooks and Soulé discovered that scrub bird diversity, the number of different species present, was higher in areas where coyotes were either present or more abundant. Domestic cats, opossum, and raccoons avoided areas where coyotes were most active. Coyotes often kill domestic cats where they cohabit.

Unlike wild predators, including coyotes, domestic cats are recreational hunters; they continue to kill birds even when bird populations are low. Crooks and Soulé found that 84% of outdoor cats brought back kills to their homes. Cat owners reported that each outdoor cat who hunted returned on average 24 rodents, 15 birds, and 17 lizards to the residence each year, a large number of victims. The level of bird predation was unsustainable, and least 75 local extinctions have occurred in these areas over the past century.

Because of their incredible adaptability, coyotes have been hunted for more than a century because some people consider them to be pests. Wildlife Services (formerly called Animal Damage Control), a branch of the United States Department of Agriculture (U.S.D.A.), slaughters tens of thousands coyotes each year (about 86,000 in 1999, 10% more than in the previous year despite claims that Wildlife Services is switching to nonlethal techniques) because coyotes supposedly are rampant predators on livestock. Livestock protection programs cost taxpayers about \$10–11 million annually. In Colorado, more than 90% of Wildlife Service's money (\$1.1 million) is spent on lethal control of native wildlife. Federal extermination efforts have been conducted since 1885, and during the past 50 years about 3.5 million coyotes have been killed. Killing methods—trapping (28% of control efforts), poisoning (21%), shooting from airplanes (aerial gunning, 33%), and snaring and other procedures (18%)—are considered by many to be inhumane and indiscriminate, and other predators, domestic dogs, and endangered species also fall victim. In Colorado alone, during the 1999–2000 harvest season, about 26,000 coyotes were killed by private hunters.

Coyotes are often controlled using aircraft. Aerial gunners killed almost 31,000 coyotes in 1999 (along with 17 ravens, 180 red foxes and 390 bobcats). According to the Boulder-based



**Female coyote and her young howling.**

© Charlie Heidecker / Visuals Unlimited.



*A coyote (Canis latrans) curled up on the ground.*  
Tom Murphy/National Geographic Image Collection.

conservation organization Sinapu, there have been 18 airplane crashes since 1989 resulting in 7 deaths and 21 injuries. The cost of aerial gunning to taxpayers ranges from \$180 to \$800 per animal. This comes to about \$5.7 million spent on aerial gunning annually. Often tens of thousands of dollars are used to capture a single coyote who might be responsible for a few hundred dollars of damage or not blamable at all. A study conducted at Utah State University showed that gunning down coyotes from helicopters is actually ineffective in that there is not a significant decrease in predation on livestock. In another study done at Utah State, coyotes, some of whom were seriously injured, were kept in leghold traps for long periods of time to determine the effects of tranquilizers to keep them calm when they were in pain.

Coyotes are a wonderful example of a sly animal for whom it is essential to know about their versatile behavior and their ability “to wear many different hats.” Wanton killing does not work because little attention is paid to the versatile behavior of these adaptable predators. And disease and unsanitary conditions frequently cause more livestock death than do coyotes or other predators. Only rarely is “the problem” coyote caught or killed, and when coyotes are killed others take their place. There is also some preliminary evidence that, in areas where coyotes are killed, their birth rates and litter size increase, the result of which is the maintenance or increase in coyote numbers. If the positive correlation between level of exploitation and coyote reproductive productivity turns out to be true, this would be another reason not to remove coyotes from an area in order to control their numbers. If we knew more about coyote behavior and also spent more time trying to understand why they are such adaptable beings, we could develop more effective and humane ways to coexist with them.

Loved or hated and feared by many, coyotes have defied virtually all attempts to control their clever ways. Coyotes are amazing animals. They offer valuable lessons in survival. Their incredible behavioral flexibility, their ability to adapt to innumerable habitats and ecological niches, and their intimate role in numerous webs of nature are good reasons for studying them in more detail rather than needlessly slaughtering them. Though coyotes try our patience, they are a model animal for learning about adaptability and success by non-human individuals striving to make it in a human dominated world. Coyotes, like Proteus the Greek who could change his form at will and avoid capture, are truly “protean predators.” They are a success story, perhaps hapless victims of their own success.

See also Wolf Behavior—*Learning to Live in Life or Death Situations*

*See also* Wolf Behavior—*Learning to Live in Life or Death Situations*

### Further Resources

Ballard, W. B., Carbyn, L. N. & Smith, D. W. 2003. *Wolf interactions with non-prey*. In: *Wolves: Behavior, Ecology, and Conservation*. (Ed. by L. David Mech & L. Boitani), pp. 259–271. Chicago: University of Chicago Press.

- Bekoff, M. (Ed.) 1978/2001. *Coyotes: Biology, Behavior, and Management*. New York: Academic Press. Reprinted in 2001 by Blackburn Press, West Caldwell, New Jersey.
- Bekoff, M. 2001. *Cunning coyotes: Tireless tricksters, protean predators*. In: *Model Systems in Behavioral Ecology* (Ed. by L. Dugatkin), pp. 381–407. Princeton: Princeton University Press.
- Bekoff, M. & Gese, E. 2003. *Coyote, Canis latrans*. In: *Wild mammals of North America: Biology, Management and Conservation* (Ed. by J. Chapman & G. Feldhamer), pp. 467–481. Baltimore, MD: John Hopkins University Press.
- Bekoff, M. & Wells, M. C. 1986. *Social behavior and ecology of coyotes*. *Advances in the Study of Behavior*, 16, 251–338.
- Crooks, K. R. & Soulé, M. E. 1999. *Mesopredator release and avifaunal extinctions in a fragmented system*. *Nature*, 400, 563–566.

Two videos (*Song Dog* and *Wolf Pack*) that contain much information on the behavior of coyotes and their interactions with other predators are available from the wildlife photographer, Bob Landis who lives in Gardiner, Montana). See his entry, *Careers—Wildlife Filmmaking*.

*Marc Bekoff*

## ■ Craig, Wallace (1876–1954)

Wallace Craig (1876–1954) was an American zoologist and psychologist who made important contributions to the study of animal instinct. His ideas proved of special importance to Konrad Lorenz when the latter was developing his own theory of instinct, and thus the conceptual foundations of the new science of ethology.

Craig studied under Charles Otis Whitman at the University of Chicago. Whitman taught him the importance of studying animal behavior comparatively. Working with Whitman's collection of pigeons, Craig focused in particular on the behavior of the ring dove, but he also made observations on other pigeon species, including the passenger pigeon, a species which was about to become extinct.

Craig earned his Ph.D. from the University of Chicago in 1908 and then went to teach psychology at the University of Maine. In 1918 he published the single most significant paper of his career, entitled "Appetites and Aversions as Constituents of Instincts." There he explained that instincts were something more than innate reflex actions, contrary to what many people in his day supposed. He maintained that appetites arising with the organism, not reflexive responses to stimuli coming from outside the organism, were what set an animal's cycles of instinctive behavior into motion. He also observed that the longer it had been since an animal performed a certain instinctive action, the easier it became for that action to be "released" by stimuli that were weaker or less appropriate than the kind of stimuli that normally released it.

Among Craig's other interesting publications was a paper of 1921 entitled: "Why Do Animals Fight?" He maintained in this paper that aggression is not an instinct. Pigeons, he found, have no special appetite for fighting. A pigeon does not seek to fight other birds, nor does it seek to prolong a fight when in one. When it did fight, it did so simply to rid itself of a stimulus that irritated it.

After Konrad Lorenz read Craig's paper of 1918, he began to emancipate himself from the chain-reflex image of animal instincts. On the other hand, he paid no attention to Craig's analysis of why animals fight and to Craig's denial that aggression in animals is an instinct. Lorenz's own theory of aggression, made popular in the 1960s in his book,