October 2004

Central and North America (Nearctic)

E. M. Gese
USDA/APHIS/WS National Wildlife Research Center, eric.gese@usu.edu

M. Bekoff

Published in *Canids: foxes, wolves, jackals, and dogs,* ed. C. Sillero-Zubiri, M. Hoffman, and D.W. Macdonald. IUCN World Conservation Union/SSC Canid Specialist Group, Gland, Switzerland and Cambridge, United Kingdom, 2004.

Chapter 4

Central and North America (Nearctic)

4.1 Coyote
Canis latrans Say, 1823
Least Concern (2004)

E.M. Gese and M. Bekoff

Other names

English: brush wolf, prairie wolf, American jackal; **Spanish:** coyote; **Indigenous names:** Aztec: coyotl; Maya: pek'i'cash (Central America); Cree and Saulteaux: mista-chagonis; Dakota: mica or micaksica; Omaha: mikasi; Mandan: scheke; Hidatsa: motsa; Arikarus: stshirits pukatsh; Klamath: ko-ha-a; Piute: eja-ah; Chinook: italipas; Yakima: telipa; Flathead: sinchlep (North America) (Young and Jackson 1951; Reid 1997).

Taxonomy

Canis latrans Say, 1823 (described by Thomas Say in Long and Long 1823:168). Type locality: "engineer cantonment"...reported in Young and Jackson (1951) as "about 12 miles south-east of the present town of Blair, Washington County, Nebraska..."

"By the late Pliocene, the ancestral coyote, *Canis lepophagus*, was widespread throughout North America" (Bekoff 1982). In the north-eastern United States, the eastern coyote may be a subspecies having coyote ancestry with some introgression of wolf and dog genes (Hilton 1978; Wayne and Lehman 1992; but see Thurber and Peterson 1991; Larivière and Crête 1993).

Chromosome number: 2n=78 (Wayne *et al*. 1987).

Description

Coyotes appear slender with "a long, narrow, pointed nose; small rounded nose pads; large pointed ears; slender legs; small feet; and a bushy tail..." (Young and Jackson 1951). Size varies geographically (Young and Jackson 1951) (Table 4.1.1), although adult males are heavier and larger than adult females. They range in colour from pure grey to rufous; melanistic coyotes are rare (Young and Jackson 1951). Fur texture and colour varies geographically: northern subspecies have long coarse hair, coyotes in the desert tend to be fulvous in colour, while coyotes at higher latitudes are darker and more grey (Young and Jackson 1951). The belly and throat are paler than the rest of the body with a saddle of darker hair over the shoulders. The tip of the tail is usually black. Hairs are about 50–90mm long; mane hairs tend to be 80–110mm long. Pelage during

Table 4.1.1 Body measurements for the coyote.

	Las Animas County, Colorado, USA (E.M. Gese unpubl.)	**Maine, USA** (Richens and Hugie 1974)
HB male	842mm (740–940) n=38	888 mm, n=26
HB female	824mm (730–940) n=36	836 mm, n=21
T male	323mm (290–350) n=10	363 mm, n=26
T female	296mm (260–340) n=10	343 mm, n=21
HF male	186mm (180–200) n=6	209 mm, n=23
HF female	180mm (170–190) n=6	197 mm, n=21
WT male	11.6kg (7.8–14.8) n=86	15.8kg, n=28
WT female	10.1kg (7.7–14.5) n=73	13.7kg, n=20

David Shackleton

Adult coyote, sex unknown, in full winter coat. Manning Provincial Park, British Columbia, Canada.

summer is shorter than in winter. The dental formula is 3/3-1/1-4/4-2/3=42.

Subspecies Young and Jackson (1951) recognised 19 subspecies. However, the taxonomic validity of individual subspecies is questionable (Nowak 1978).

— *C. l. latrans* (Great Plains region of the U.S. and southern Canada)
— *C. l. ochropus* (west coast of the U.S.)
— *C. l. cagottis* (south-eastern Mexico)
— *C. l. frustror* (parts of Oklahoma, Texas, Missouri, Kansas in the U.S.)
— *C. l. lestes* (intermountain and north-west U.S., south-west Canada)
— *C. l. mearnsi* (south-western U.S., north-western Mexico)
— *C. l. microdon* (north-eastern Mexico, southern Texas in the U.S.)
— *C. l. peninsulae* (Baja California of Mexico)
— *C. l. vigilis* (south-western Mexico)
— *C. l. clepticus* (Baja California of Mexico)
— *C. l. impavidus* (western Mexico)
— *C. l. goldmani* (southern Mexico, Belize, Guatemala)
— *C. l. texensis* (Texas and New Mexico in the U.S.)
— *C. l. jamesi* (Tiburon Island, Baja California of Mexico)
— *C. l. dickeyi* (El Salvador, Honduras, Nicaragua, Costa Rica)
— *C. l. incolatus* (Alaska in the U.S., north-western Canada)
— *C. l. hondurensis* (Honduras)
— *C. l. thamnos* (Great Lakes region of the U.S. and Canada, north central Canada)
— *C. l. umpquensis* (west coast of north-western U.S.)

Similar species Coyotes can be confused with grey wolves (*C. lupus*), red wolves (*C. rufus*), and domestic dogs. Coyotes usually can be differentiated from these congenerics using serologic parameters, dental characteristics, cranial measurements, neuroanatomical features, diameter of the nose pad, diameter of the hindfoot pad, ear length, track size, stride length, pelage, behaviour, and genetics (Bekoff 1982; Bekoff and Gese 2003; and references therein). Coyotes may be differentiated from domestic dogs using the ratio of palatal width (distance between the inner margins of the alveoli of the upper first molars) to the length of the upper molar tooth row (from the anterior margin of the alveolus of the first premolar to the posterior margin of the last molar alveolus) (Howard 1949; Bekoff 1982; and references therein). If the tooth row is 3.1 times the palatal width, then the specimen is a coyote; if the ratio is less than 2.7, the specimen is a dog (this method is about 95% reliable) (Bekoff 1982). Unfortunately, fertile hybrids are known between coyotes and dogs, red and grey wolves, and golden jackals (Young and Jackson 1951; Bekoff and Gese 2003; and references therein).

Grey wolf (*C. lupus*): larger than coyotes, though with a relatively smaller braincase; nose pad and hindfoot pads are larger (Bekoff 1982; and references therein). There is no overlap when comparing large coyotes to small wolves in zygomatic breadth, greatest length of the skull, or bite ratio (width across the outer edges of the alveoli of the anterior lobes of the upper carnassials divided by the length of the upper molar toothrow) (Paradiso and Nowak 1971; Bekoff 1982; and references therein).

Red wolf (*C. rufus*): usually larger than coyotes with almost no overlap in greatest length of skull; more pronounced sagittal crest (Bekoff 1982; and references therein).

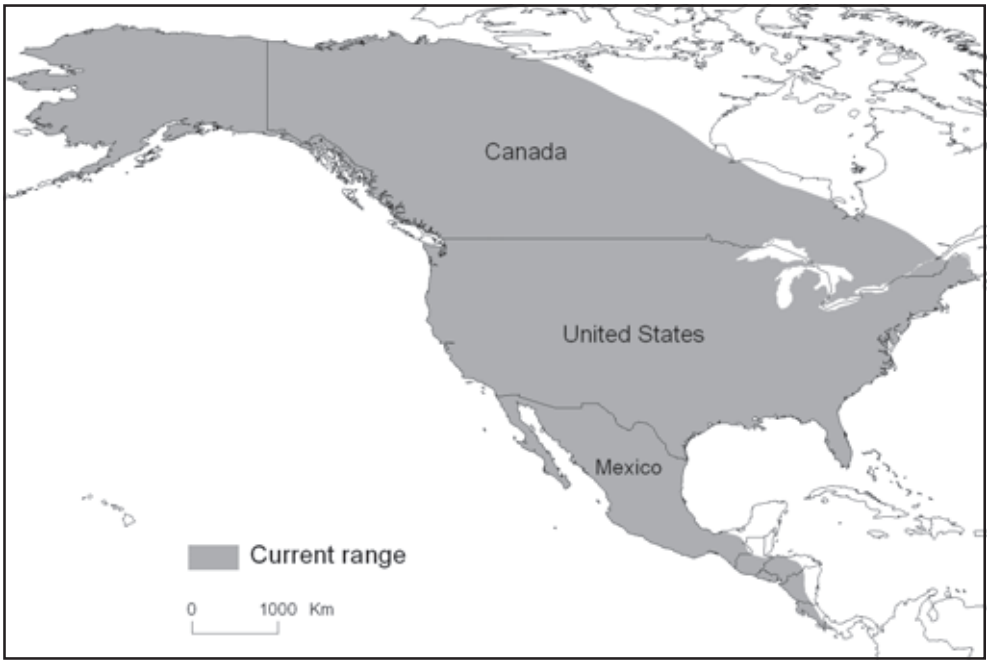

Figure 4.1.1. Current distribution of the coyote.

Distribution

Historical distribution Coyotes were believed to have been restricted to the south-west and plains regions of the U.S. and Canada, and northern and central Mexico, prior to European settlement (Moore and Parker 1992). During the 19th century, coyotes are thought to have expanded north and west. With land conversion and removal of wolves after 1900, coyotes expanded into all of the U.S. and Mexico, southward into Central America, and northward into most of Canada and Alaska (Moore and Parker 1992).

Current distribution Coyotes continue to expand their distribution and occupy most areas between 8°N (Panama) and 70°N (northern Alaska) (Figure 4.1.1). They are found throughout the continental United States and Alaska, almost all of Canada (except the far north-eastern regions), south through Mexico and into Central America (Bekoff 1982; Reid 1997; Bekoff and Gese 2003).

Range countries Belize, Canada, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, United States of America (Moore and Parker 1992; Reid 1997; Bekoff and Gese 2003).

Relative abundance

Coyotes are abundant throughout their range (Table 4.1.3) and are increasing in distribution as humans continue to modify the landscape. Elimination of wolves may also have assisted coyote expansion. Coyote density varies geographically with food and climate, and seasonally due to mortality and changes in pack structure and food abundance. Local control temporarily reduces numbers on a short-term basis, but coyote populations generally are stable in most areas.

Coyote densities in different geographic areas and seasons (Table 4.1.2) vary from 0.01–0.09 coyotes/km² in the winter in the Yukon (O'Donoghue *et al*. 1997) to 0.9/km² in the fall and 2.3/km² during the summer (post-whelping) in Texas (Knowlton 1972; Andelt 1985).

Table 4.1.2. Coyote densities in different geographic areas and seasons.

Location	Density	Season	Source
Alberta	0.1–0.6	Winter	Nellis & Keith 1976
	0.08–0.44	Winter	Todd *et al*. 1981
Colorado	0.26–0.33	Pre-whelp	Gese *et al*. 1989
	0.7	Winter	Hein & Andelt 1995
Montana	0.15	Spring	Pyrah 1984
	0.39	Summer	Pyrah 1984
Tennessee	0.35	Pre-whelp	Babb & Kennedy 1989
Texas	0.9	Post-whelp	Knowlton 1972
	1.5–2.3	Autumn	Knowlton 1972
	0.9	Pre-whelp	Andelt 1985
	0.12–0.14	Pre-whelp	Henke & Bryant 1999
Yukon	0.01–0.09	Winter	O'Donoghue *et al*. 1997

Estimated populations/relative abundance and population trends

Table 4.1.3. The status of coyotes in various range countries (Population: A=abundant, C=common, U=uncommon; Trend: I=increasing, S=stable, D=declining).

Country	Population abundance	Trend
Belize	U	I
Canada	A	I
Costa Rica	U	I
El Salvador	C	I
Guatemala	C	I
Honduras	C	I
Mexico	A	I
Nicaragua	C	I
Panama	U	I
United States	A	I

Habitat

Coyotes utilise almost all available habitats including prairie, forest, desert, mountain, and tropical ecosystems. The ability of coyotes to exploit human resources allows them to occupy urban areas. Water availability may limit coyote distribution in some desert environments.

Food and foraging behaviour

Food Coyotes are opportunistic, generalist predators that eat a variety of food items, typically consuming items in relation to changes in availability. Coyotes eat foods ranging from fruit and insects to large ungulates and livestock. Livestock and wild ungulates may often be represented in coyote stomachs and scats as carrion, but predation on large ungulates (native and domestic) does occur (Andelt 1987). Predation by coyotes on neonates of native ungulates can be high during fawning (Andelt 1987). Coyotes in suburban areas are adept at exploiting human-made food resources and will readily consume dog food or other human-related items.

Foraging behaviour Studies on the predatory behaviour of coyotes show that age of the coyote, wind, habitat, and snow conditions all influence their ability to capture small mammals (Bekoff and Wells 1986; Gese *et al*. 1996a). Coyotes hunt small mammals alone, even when pack size is large (Gese *et al*. 1996a). When preying on native ungulates, cooperation among pack members may facilitate the capture of prey, but is not essential. Environmental factors are important to the success of an attack on adult ungulates. Presence of the alpha pair is important in determining the success of the attack, and younger animals generally do not participate. The number of coyotes is not as important as who is involved in the attack (Gese and Grothe 1995). Also,

the ability of the ungulate to escape into water, defensive abilities of the individual and cohorts, and nutritional state of the individual under attack, contribute to the outcome (Gese and Grothe 1995). In areas with an ungulate prey base in winter, resource partitioning and competition for a carcass may be intense, even among members of the same pack (Gese *et al*. 1996b). When coyotes prey on sheep, they generally attack by biting the throat and suffocating the animal. Defensive behaviours by sheep sometimes can deter coyotes from continuing their attack.

Coyotes may be active throughout the day, but they tend to be more active during the early morning and around sunset (Andelt 1985). Activity patterns change seasonally, or in response to human disturbance and persecution (Kitchen *et al*. 2000a). Activity patterns change during winter, when there is a change in the food base (Bekoff and Wells 1986; Gese *et al*. 1996b).

Damage to livestock or game Coyotes are a major predator of domestic sheep and lambs. In areas with predator control, losses to coyotes were 1.0–6.0% for lambs and 0.1–2.0% for ewes (USFWS 1978). In areas with no predator control, losses to coyotes were 12–29% of lambs and 1–8% of ewes (McAdoo and Klebenow 1978; O'Gara *et al*. 1983). However, coyote predation is not always the major cause of losses. In 1999, the value of sheep reported lost to predators was estimated at US$16.5 million (USDA 2000). In 1999, predators killed an estimated 273,600 sheep and lambs, with coyotes causing 60.7% of those losses (USDA 2000). Of the 742,900 sheep and lambs reported lost in 1999, only 165,800 (22.3%) were killed by coyotes (USDA 2000). However, not all losses are necessarily reported.

Predation by coyotes on game species can be very high, particularly among fawns (Andelt 1987). Losses due to predation can be 40–90% of the ungulate fawn crop, with coyotes being one of the major predators (Andelt 1987). Predation by coyotes on adult ungulates is less pronounced compared to neonatal predation. The effect that coyote predation has on the adult segment of ungulate populations is poorly understood, but in some situations increased predation may be correlated with winter severity.

Adaptations

Coyotes are very versatile, especially in their ability to exploit human-modified environments. Their plasticity in behaviour, social ecology, and diet allows coyotes to not only exploit, but to thrive, in almost all environments modified by humans. Physiologically, the insulative properties of their fur allow coyotes to adapt to cold environments (Ogle and Farris 1973). In deserts, lack of free water may limit their distribution compared to smaller canids.

Social behaviour

Coyotes are considered less social than wolves (but see Gese *et al*. 1996b, c). The basic social unit is the adult, heterosexual pair, referred to as the alpha pair. Coyotes form heterosexual pair bonds that may persist for several years, but not necessarily for life. Coyotes may maintain pair bonds and whelp or sire pups up to 10–12 years of age. Associate animals may remain in the pack and possibly inherit or displace members of the breeding pair and become alphas themselves. Associates participate in territorial maintenance and pup rearing, but not to the extent of the alpha pair. Other coyotes exist outside of the resident packs as transient or nomadic individuals. Transients travel alone over larger areas and do not breed, but will move into territories when vacancies occur.

One factor that may affect coyote sociality is prey size or prey biomass. In populations where rodents are the major prey, coyotes tend to be in pairs or trios (Bekoff and Wells 1986). In populations where elk and deer are available, large packs of up to 10 individuals may form (Bekoff and Wells 1986; Gese *et al*. 1996b, c).

Coyotes are territorial with a dominance hierarchy within each resident pack (Bekoff 1982; Bekoff and Gese 2003, and references therein). In captivity, coyotes show early development of aggressive behaviour and engage in dominance fights when 19–24 days old (Bekoff *et al*. 1981). The early development of hierarchical ranks within litters appears to last up to 4.5 months (Bekoff 1977). Territoriality mediates the regulation of coyote numbers as packs space themselves across the landscape in relation to available food and habitat (Knowlton *et al*. 1999). The dominance hierarchy influences access to food resources within the pack (Gese *et al*. 1996b, c).

Home-range size varies geographically (Laundré and Keller 1984), and among residents, varies with energetic requirements, physiographic makeup, habitat, and food distribution (Laundré and Keller 1984). Home-range size is influenced by social organisation, with transients using larger areas, and residents occupying distinct territories (Andelt 1985; Bekoff and Wells 1986). Resident coyotes actively defend territories with direct confrontation, and indirectly with scent marking and howling (Camenzind 1978; Bekoff and Wells 1986). Only packs (2–10 animals) maintain and defend territories (Bekoff and Wells 1986). Fidelity to the home range area is high and may persist for many years (Kitchen *et al*. 2000b). Shifts in territorial boundaries may occur in response to loss of one or both of the alpha pair (Camenzind 1978).

Dispersal of coyotes from the natal site may be into a vacant or occupied territory in an adjacent area, or they may disperse long distances. Generally, pups, yearlings, and non-breeding adults of lower social rank disperse (Gese *et al*. 1996c). Dispersal seems to be voluntary as social and nutritional pressures intensify during winter when food becomes limited (Gese *et al*. 1996c). There seems to be no consistent pattern in dispersal distance or direction. Dispersal by juveniles usually occurs during autumn and early winter. Pre-dispersal forays may occur prior to dispersal.

Coyotes communicate using auditory, visual, olfactory, and tactile cues. Studies have identified different types of vocalisations, seasonal and diel patterns, and the influence of social status on vocalisation rates (Bekoff and Gese 2003; and references therein). Howling plays a role in territorial maintenance and pack spacing by advertising territorial boundaries and signalling the presence of alpha animals which will confront intruders and defend the territory. Studies on scent marking have shown that alpha coyotes perform most scent marking, scent marking varies seasonally, and scent marks contribute to territory maintenance (Bekoff and Gese 2003; and references therein). Scent marking may also be a mechanism for sex recognition and an indicator of sexual condition, maturity, or synchrony (Bekoff and Gese 2003; and references therein).

Reproduction and denning behaviour

Descriptions of spermatogenesis and the oestrous cycle show that both males and females show annual cyclic changes in reproductive anatomy and physiology (Kennelly 1978). Females are seasonally monoestrus, showing one period of heat per year between January and March, depending on geographic locale (Kennelly 1978). Pro-oestrus lasts 2–3 months and oestrus up to 10 days. Courtship behaviour begins 2–3 months before copulation (Bekoff and Diamond 1976). Copulation ends with a copulatory tie lasting up to 25 minutes. Juvenile males and females are able to breed.

The percentage of females breeding each year varies with local conditions and food supply (Knowlton *et al.* 1999). Usually, about 60–90% of adult females and 0–70% of female yearlings produce litters (Knowlton *et al.* 1999). Gestation lasts about 63 days. Litter size averages about six (range=1–9) and may be affected by population density and food availability during the previous winter (Knowlton *et al.* 1999). In northern latitudes, coyote litter size changes in response to cycles in snowshoe hares (*Lepus americanus*) (Todd and Keith 1983; O'Donoghue *et al.* 1997). Gese *et al.* (1996b) found an increase in litter size after cold, snowy winters had increased the number of ungulate carcasses available to ovulating females. Litter sex ratio is generally 1:1 (Knowlton 1972).

Coyotes may den in brush-covered slopes, steep banks, under rock ledges, thickets, and hollow logs. Dens of other animals may be used. Dens may have more than one entrance and interconnecting tunnels. Entrances may be oriented to the south to maximise solar radiation (Gier 1968). The same den may be used from year-to-year. Denning and pup rearing are the focal point for coyote families for several months until the pups are large and mobile (Bekoff and Wells 1986).

The pups are born blind and helpless in the den. Birth weight is 240–275g; length of the body from tip of head to base of tail is about 160mm (Gier 1968). Eyes open at about 14 days and pups emerge from the den at about three weeks. The young are cared for by the parents and other associates, usually siblings from a previous year (Bekoff and Wells 1986). Pups are weaned at about 5–7 weeks of age and reach adult weight by about nine months.

Competition

Direct and indirect competition between coyotes and wolves, and pumas (*Puma concolor*) has been documented. Coyotes have been killed by wolves and may avoid areas and habitats used by these larger carnivores. Direct predation and competition for food and space with wolves may limit coyote numbers in some areas under certain conditions (Peterson 1995).

In some areas, coyotes may not tolerate bobcats (*Lynx rufus*; but see Major and Sherburne 1987) and red foxes (*Vulpes vulpes*; e.g., Major and Sherburne 1987), but appear to be more tolerant when food is abundant (Gese *et al.* 1996d). Coyotes will also kill smaller canids, mainly swift fox (*V. velox*), kit fox (*V. macrotis*), and gray fox (*Urocyon cinereoargenteus*). Coexistence between these canids may be mediated by resource partitioning (e.g., White *et al.* 1995; Kitchen *et al.* 1999).

Mortality and pathogens

Natural sources of mortality Coyotes of various ages have different mortality rates depending on the level of persecution and food availability (Knowlton *et al.* 1999). Pups (<1 year old) and yearlings (1–2 years old) tend to have the highest mortality rates. For individuals >1 year of age, mortality rate varies geographically (Knowlton 1972). Knowlton (1972) reported high survival from 4–8 years of age. About 70–75% of coyote populations are 1–4 years of age (Knowlton *et al.* 1999).

Predation by large carnivores and starvation may be substantial mortality factors, but their effects on coyote populations are poorly understood. Increased mortality is often associated with dispersal as animals move into unfamiliar areas and low-security habitats (Knowlton *et al.* 1999).

Persecution Even in lightly exploited populations, most mortality is attributable to humans. Human exploitation can be substantial in some coyote populations (Knowlton *et al.* 1999). Human activity causes a high proportion of deaths of coyotes, with protection of livestock and big game species constituting one of the greatest motives for persecuting coyotes. Harvest of coyotes as a furbearer also continues throughout its range.

Hunting and trapping for fur Coyotes are harvested for their fur in many states in the U.S. and several provinces in Canada.

Road kills Coyotes are subject to vehicular collisions throughout their range.

Pathogens and parasites Disease can be a substantial mortality factor, especially among pups (e.g., Gese *et al.* 1997). Serological analyses for antibodies in coyotes show that they have been exposed to many diseases. Generally, the effects of these diseases on coyote populations are unknown. Prevalence of antibodies against canine parvovirus, canine distemper, and canine infectious hepatitis varies geographically (Bekoff and Gese 2003; and references therein). The prevalence of antibodies against plague (*Yersinia pestis*) ranges from <6% in California (Thomas and Hughes 1992) to levels >50% (Gese *et al.* 1997); prevalence of antibodies against tularemia (*Francisella tularensis*) ranges from 0% in coyotes in Texas (Trainer and Knowlton 1968) to 88% in Idaho (Gier *et al.* 1978). Serologic evidence of exposure to brucellosis and leptospirosis varies across locales (Bekoff and Gese 2003; and references therein). Coyotes in an urban area are equally exposed to pathogens (Grinder and Krausman 2001).

Coyotes are inflicted with a variety of parasites, including fleas, ticks, lice, cestodes, round-worms, nematodes, intestinal worms, hookworms, heartworms, whipworms, pinworms, thorny-headed worms, lungworms, and coccidia fungus (see Gier *et al.* 1978; Bekoff and Gese 2003; and references therein). Coyotes may carry rabies and suffer from mange, cancer, cardiovascular diseases, and aortic aneurysms (Bekoff and Gese 2003; and references therein).

Longevity Coyotes in captivity may live as long as 21 years (Linhart and Knowlton 1967), but in the wild, life expectancy is much shorter; maximum age reported for a wild coyote is 15.5 years (Gese 1990).

Historical perspective

Coyotes were an important element in Native American mythology. The term coyote is derived from the Aztec term "coyotl." In Crow mythology, Old Man Coyote played the role of trickster, transformer, and fool. In the south-west, the Navajo called the coyote "God's dog." Among the tribes of the Great Plains, the coyote was "God of the Plains." In the culture of the Flathead Indians, the coyote was regarded as "most powerful, and favourable to mankind" (Young and Jackson 1951). With European expansion into the western U.S., the coyote came into conflict with domestic livestock. Predator control programmes began in the 1800s with the intention of ridding the west of predators. While the wolf and grizzly bear were reduced or extirpated throughout most of their former ranges, the coyote thrived and expanded into these human-modified landscapes. Today, the coyote is distributed throughout the continental U.S. and Mexico, most of Canada and Alaska, and much of Central America. While local control continues, the coyote has firmly established itself as the "trickster" of native lore and is here to stay.

Conservation status

Threats There are no current threats to coyote populations throughout their range. Local reductions are temporary and their range has been expanding. Conservation measures have not been needed to maintain viable populations. Coyotes adapt to human environs and occupy most habitats, including urban areas. Hybridisation with dogs may be a threat near urban areas. Genetic contamination between dogs, coyotes, and wolves may be occurring in north-eastern U.S. Hybridisation between coyotes and red wolves is problematic for red wolf recovery programmes.

Commercial use Coyote fur is still sought by trappers throughout its range, with harvest levels depending upon fur prices, local and state regulations, and traditional uses and practices. Many states and provinces consider coyotes a furbearing species with varying regulations on method of take, bag limit, and seasons.

Occurrence in protected areas The coyote occurs in almost all protected areas across its range.

Protection status CITES – not listed.

Current legal protection No legal protection. Restrictions on harvest and method of harvest depend upon state or provincial regulations.

Conservation measures taken None at present.

Occurrence in captivity

Over 2,000 coyotes occur in captivity in zoos, wildlife centres, and so on throughout their range. They readily reproduce in captivity and survival is high.

Current or planned research projects

Due to the wide distribution of coyotes throughout North and Central America, coyote research continues across its range. Because the coyote is so numerous, much of the research does not focus on conservation measures, but usually on community dynamics, predator-prey relationships, disease transmission, and coyote-livestock conflicts. Over 20 studies are currently being conducted in the U.S., Canada, Mexico, and Central America.

Gaps in knowledge

Several gaps in knowledge still remain: coyote reproductive physiology and possible modes of fertility control; selective management of problem animals; effects of control; genetic differentiation from other canids (particularly the red wolf); development of non-lethal depredation techniques; interactions of coyotes and other predators; coyote-prey interactions; human-coyote interactions and conflicts at the urban interface; factors

influencing prey selection; communication; adaptations in urban and rural environments; and interactions with threatened species.

Core literature

Andelt 1985, 1987; Bekoff and Gese 2003; Bekoff and Wells 1986; Gese *et al*. 1996a, b, c; Gier 1968; Knowlton *et al*. 1999; Young and Jackson 1951.

Reviewers: William Andelt, Lu Carbyn, Frederick Knowlton. **Editors:** Claudio Sillero-Zubiri, Deborah Randall, Michael Hoffmann.

4.2 Red wolf
Canis rufus Audubon and Bachman, 1851
Critically Endangered – CR: D (2004)

B.T. Kelly, A. Beyer and M.K. Phillips

Other names

None.

Taxonomy

Canis rufus Audubon and Bachman, 1851. Viviparous quadrupeds of North America, 2:240. Type locality: not given. Restricted by Goldman (1937) to "15 miles of Austin, Texas" [USA].

In recent history the taxonomic status of the red wolf has been widely debated. Mech (1970) suggested red wolves may be fertile hybrid offspring from grey wolf (*Canis lupus*) and coyote (*C. latrans*) interbreeding. Wayne and Jenks (1991) and Roy *et al*. (1994b, 1996) supported this suggestion with genetic analysis. Phillips and Henry (1992) present logic supporting the contention that the red wolf is a subspecies of grey wolf. However, recent genetic and morphological evidence suggests the red wolf is a unique taxon. Wilson *et al*. (2000) report that grey wolves (*Canis lupus lycaon*) in southern Ontario appear genetically very similar to the red wolf and that these two canids may be subspecies of one another and not a subspecies of grey wolf. Wilson *et al*. (2000) propose that red wolves and *C. lupus lycaon* should be a separate species, *C. lycaon*, and their minor differences acknowledged via subspecies designation. A recent meeting of North American wolf biologists and geneticists also concluded that *C. rufus* and *C. lupus lycaon* were genetically more similar to each other than either was to *C. lupus* or *C. latrans* (B.T. Kelly unpubl.). Recent morphometric analyses of skulls also indicate that the red wolf is likely not to be a grey wolf × coyote hybrid (Nowak 2002). Therefore, while the red wolf's taxonomic status remains unclear, there is mounting evidence to support *C. rufus* as a unique canid taxon.

Chromosome number: 2n=78 (Wayne 1993).

Description

The red wolf generally appears long-legged and rangy with proportionately large ears. The species is intermediate in size between the coyote and grey wolf. The red wolf's almond-shaped eyes, broad muzzle, and wide nose pad contribute to its wolf-like appearance. The muzzle tends to be very light with an area of white around the lips extending up the sides of the muzzle. Coloration is typically brownish or cinnamon with grey and black shading on the back and tail. A black phase occurred historically but is

Male red wolf, age unknown.

Art Beyer