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Coyote (*Canis latrans*)

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Abstract—*Canis latrans* (Say 1823) is a canid commonly called the coyote. It is dog-like in appearance with varied colorations throughout its range. Originally restricted to the western portion of North America, coyotes have expanded across the majority of the continent. Coyotes are omnivorous and extremely adaptable, often populating urban and suburban environments. Preferred habitats include a mixture of forested, open, and brushy areas. Currently, there exist no threats or conservation concerns for the coyote in any part of its range. This species is currently experiencing an increasing population trend.

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Coyote

Canis latrans (Say, 1823)

CONTEXT AND CONTENT.

Order Carnivora, suborder Caniformia, infraorder Cynoidea, family Canidae, subfamily Caninae, tribe Canini. Genus *Canis* consists of six species: *C. aureus*, *C. latrans*, *C. lupus*, *C. mesomelas*, *C. simensis*, and *C. adustus*. *Canis latrans* has 19 recognized subspecies (Wilson and Reeder 2005).

GENERAL CHARACTERS

The weight range of the coyote (Fig. 1) is about 8–20 kg with size variation attributed to subspecies differences and geographic



Fig. 1. Typical adult male coyote. Used with permission of the photographer Billie Cromwell/retired Pennsylvania Game Commission.

location (Jackson 1951; Young 1951; Berg and Chesness 1978; Way 2007). The species is sexually dimorphic, with adult females distinctly lighter and smaller than adult males (Kennedy et al. 2003; Way 2007). Average head and body lengths are about 1.0–1.5 m with a tail length of about Young 1951). The skull of the coyote (Fig. 2) progresses through 6 distinct developmental stages allowing delineation between the age classes of juvenile, immature, young, young adult, adult, and old adult (Jackson 1951). Skull lengths of adult males range from 180 to 200 mm (Gier 1968).

Coyote fur varies greatly in color and texture, ranging from gray to red and from long and dense (northern subspecies) to short and fine (southern subspecies). Short under fur and longer guard hairs comprise the pelage, which



Fig. 2. Skull of an adult coyote. Photograph from Skulls Unlimited International. www.skullsunlimited.com



Fig. 3—Geographic distribution of *Canis latrans*. Adapted from Jackson (1951), Hill et al. (1987), and Thornton et al. (2004). Created using ArcGIS.

is molted annually (Jackson 1951). Colors are generally blended and banded with lighter coloration on the underside of the animal. Melanism and albinism are rare in this species (Young 1951).

DISTRIBUTION

The distribution of the coyote (Fig. 3) covers most of North and Central America from Costa Rica to northern Alaska and from the Pacific coast to the Atlantic coast (Jackson 1951; Hill et al. 1987). Originally restricted to the western portion of the continent, coyotes recently expanded into the southeastern United States around the 1950s. This expansion may have been influenced and accelerated by humans (Hill et al. 1987). Coyotes appeared in Mississippi during the early 1960s (Nowak 1978) and are now found throughout the state (Hill et al. 1987; Lovell et al. 1998). The most recent point of expansion in the southeastern United States is the state of Florida, in which coyotes now occupy the vast majority of the area (Thornton et al. 2004).

FORM AND FUNCTION

Coyotes can be distinguished by erect ears, a full and straight tail, a visible black spot on the tail marking a scent gland, and a V-shaped shoulder harness (Hilton 1978). The scent gland at the base of the tail produces a marker for each individual in the form of a unique

scent (Young 1951). Coyotes normally have 8 mammary glands (Hildebrand 1952). Four toes are present on each hind foot and five toes are present on each fore foot with the first digit high and on the inside (dewclaw). Claws are blunt and do not retract (Jackson 1951). The dental formula is: $i\ 3/3, c\ 1/1, p\ 4/4, m\ 2/3$, total 42 (Slaughter et al. 1974).

The coyote's central nervous system is similar to that of a domestic dog (Atkins 1978). The adrenal glands of coyotes do not differ significantly from other members of Canidae. The left adrenal is heavier than the right, regardless of sex, but overall the female adrenal glands are larger than male adrenal glands (Heinrich 1972).

Winter pelage of the coyote is highly insulative and greatly increases heat conservation (Ogle and Farris 1973). An annual molt occurs from summer to fall. Prior to molting, fur appears heavily worn and faded (Jackson 1951). Urination and defecation is used to indicate reproductive status as well as territorial boundaries (Gese and Ruff 1997). Optimal auditory sensitivity in coyotes ranges from 100 Hz to 30 kHz (Petersen et al. 1969). The retina consists of rods and cones with rods being more numerous, which indicates good night vision ability but little color perception (Horn and Lehner 1975). Coyotes are most active at night and during crepuscular periods (Bekoff and Wells 1980; Thornton et al. 2004).

ONTOGENY AND REPRODUCTION

The mating season for coyotes is mid-January through late March. Litters of 3 to 7 pups are born from March to May after a gestation of 60–63 days (Mengel 1971; Carlson and Gese 2008). Both the male and female participate in the care of the litter. Breeding pairs may remain together for several years, but not usually for life (Carlson and Gese 2008).

Increased courtship behavior begins before estrus (proestrus; January–February) as levels of estradiol and progesterone rise in females and spermatogenesis peaks in males (Kennelly 1978; Carlson and Gese 2008). Sexual activity

decreases as females approach diestrus, and levels of estradiol and progesterone subsequently decrease. Levels of prolactin and relaxin elevate in pregnant females shortly after ovulation (Carlson and Gese 2008). Both sexes exhibit regression of the gonads during the non-breeding season (Mengel 1971).

Denning activities occur from April to June, weaning occurs from June to August, and basic parental care lasts until the young disperse or become mature members of the social group (usually November). Juvenile coyotes can reach reproductive maturity in their first year, but juvenile males who disperse from their natal territory are generally more successful than the males that remain or the females of that generation (Mengel 1971; Carlson and Gese 2008).

Coyote pups average a birth weight of about 250–300 g (2.5% of average adult weight). From 3 to 8 weeks old, pups gain almost 0.5 kg per week. Eyes open at 2 weeks (14–16 days). Upper canines usually erupt first, soon followed by the eruption of the lower canines and upper incisors, which are followed by the lower incisors (Bekoff and Jamieson 1975). Adult coloration is attained within 5–6 months (Jackson 1951).

ECOLOGY

Population characteristics.—The average lifespan of the coyote is generally 10–18 years (Young 1951). Annual survival rate is 0.5–0.69 (juveniles slightly lower than adults), but this value varies from study to study (Holzman et al. 1992a; Windberg 1995). Mortality is most often affected by human activities and disease (Holzman et al. 1992a). In Mississippi, Chamberlain and Leopold (2001) found that the mortality of southeastern coyotes is primarily affected by hunting, but harvest levels are relatively low (annual survival rate approximately 0.70). Population densities have been estimated at 0.26–0.33 individuals/km². However, population densities vary by season, by region, and among different habitat types (Gese et al. 1989). Windberg's (1995) study in Texas estimated population density at

2.0 individuals/km². Sex ratios are generally 50:50, and the number of pups and yearlings are nearly equal to the number of adults in a population. Dispersal usually occurs among young coyotes in their first winter, October–January (Gese et al. 1989). Females 3–9 years of age have the most reproductive success (Windberg 1995).

Space use.—Home range of coyotes in Mississippi is not significantly affected by seasonality. Females have a slightly larger annual home range (1,850 ha) and core area (330 ha) than males (1100 ha home range, 190 ha core area—Chamberlain et al. 2000). Chamberlain et al. (2000) also showed that males and females rarely have overlapping core areas with other same-sex coyotes, but the sharing of home ranges and core areas evidenced male-female pairs. Landscape pattern does not directly influence home range size or selection of coyotes, possibly because of the extremely varied omnivorous diet of the coyote (Constible et al. 2006). In Mississippi, primary preference for young pine stands (9–15 years) in the home range has been documented, and this spatial selection is possibly due to prey abundance. Selection for mature pine stands increases after the breeding season due to the possible increase in den site availability (Chamberlain et al. 2000). In Georgia, Holzman et al. (1992b) also showed coyote preference for young pine stands, along with brushy areas, bottomland hardwoods, and open areas. Movement patterns between males and females do not differentiate much, except during pup rearing when females tend to move more, possibly to acquire more food for the young (Chamberlain et al. 2000). The presence of transient coyotes has been shown by Chamberlain et al. (2000) and others.

Diet.—Coyotes are omnivorous with feeding habitats reflecting the relative availability of food during each season. In Mississippi, the majority of the diet is composed of white-tailed deer, rabbits, and fruits such as blackberry and persimmon (Chamberlain and Leopold 1999). Other prey items found in a study conducted by Chamberlain and Leopold (1999) included

grass, insects, snake, turtle, swine, passerines, bobcat, squirrel, beaver, armadillo, wild turkey, feral cat, poultry, opossum, corn, cattle, acorns, and muskrat. Chamberlain and Leopold's (1999) study indicated that when fruits, such as persimmon, are abundant during October and November, coyotes select them over other food items, even as populations of rodents rise and the amount of deer carrion increases. This activity may indicate a seasonal shift in foraging to increase overall efficiency, suggesting that coyotes are indeed strong omnivores that can adjust well to environmental and seasonal changes with their highly varied diet (Chamber and Leopold 1999). A study of coyotes in Wisconsin also showed variation among foraging habits as seasons and prey availability changed (Gese et al. 1996).

Diseases and Parasites.—Rabies occurs sporadically throughout coyote populations. Bacterial diseases such as tularemia (contracted mainly from rabbits) may be especially dangerous to young coyotes (Gier et al. 1978). Occurrence of canine parvovirus is relatively low while there may be a large effect from canine distemper virus. Heartworm disease may also be a leading cause of mortality (Holzman et al. 1992a). Sarcoptic mange is the main type of mange affecting coyote populations. Other ectoparasites commonly infest coyotes such as ticks and fleas, while lice infestations are rare. Flatworms (such as tapeworms) and round worms can also affect mortality (Gier et al. 1978). While human interaction is a significant source of mortality in many areas, this type of mortality is lower in the southeastern United States than in other regions (Holzman et al. 1992a; Chamberlain and Leopold 2001).

Interspecific interactions.—Studies in Mississippi show that home ranges of bobcats, gray foxes, and coyotes often overlap; however, core areas rarely overlap. These species have similar activity patterns, diets, and habitat preferences, and they coexist within common areas by partitioning habitats and prey items. However, red foxes and coyotes do not coexist well (Chamberlain and Leopold 2004).

Thornton et al. (2004) also observed sympatry between bobcats and coyotes.

Miscellaneous.—Common methods of monitoring coyote populations, as recorded by Lovell et al. (1998), include: scent stations, track counts, siren-response surveys, and mark-recapture. Foot-hold traps combined with the use of tranquilizer pellets have been used for mark-recapture procedures (Bekoff and Wells 1980).

Fear of attacks on domestic animals and humans increases public desire for control of coyotes and other predators. Human-coyote interactions are increasing as coyote populations expand into even urban environments (Gompper 2002).

BEHAVIOR

Social and predatory behavior.—Coyotes often travel in pairs or groups and exhibit territoriality of their core area, although home ranges may overlap (Chamberlain et al. 2000). Solitary coyotes are not uncommon as they may become less social during periods or seasons of lower prey abundance. Availability of food plays a large role in the social structure of coyotes (Bekoff and Wells 1980). In Wyoming, Bekoff and Wells (1980) indicated a higher prevalence of groups or packs of coyotes during the winter when availability of ungulate carrion peaked. Within a pack of coyotes, a dominant breeding pair emerges, and the other non-breeding members fulfill tasks such as protecting food resources and helping with the young (Bekoff and Wells 1980).

Coyotes tend to spend more time hunting during the summer period. Increased availability of prey items such as fruits and carrion in fall and winter may be the reason coyotes are more social during these seasons (Bekoff and Wells 1980). Bekoff and Wells (1980) closely observed and described the behaviors of coyotes as they hunted small mammals. These behaviors included: scanning large areas for signs of prey, investigating smaller areas, stalking the prey, rushing or pouncing on the prey, and at last killing its

targeted prey by biting it near the head and shaking it.

Communication.—Howling is an important means of communication for coyotes. Alpha, or dominant, coyotes spend much more time howling than any other member of a pack, and howling is increased during the breeding and dispersal periods. Solitary coyotes howl considerably less than leaders of a pack. Howling serves to mark territorial boundaries and discourage intrusion. Coyotes exercise multiple vocalizations, the exact meanings of which are not yet completely understood (Gese and Ruff 1998).

Scent-marking also serves to indicate territorial boundaries, both for outsiders and members of a pack. As with howling, social class and season affect the rate of scent-marking. Alpha coyotes scent-mark more than transient coyotes and other members of the pack, and scent-marking is increased during the breeding season. In addition to marking territory, scent-marking is also used between males and females to indicate reproductive status. Ground-scratching by males is another form of communication that may be related to reproductive behavior (Gese and Ruff 1997).

GENETICS

Coyotes have 38 pairs of chromosomes, with submetacentric sex chromosomes and acrocentric or telocentric autosomes (Wurster and Benirschke 1968; Mech 1974). Hybridization between coyotes and domestic dogs is relatively common and produces fertile offspring (“coy-dogs”—Mengel 1971). Coyotes also hybridize with gray wolves and red wolves, and these three species share very similar allelic frequencies. The origin of the red wolf may be due to the hybridization of the coyote with the gray wolf (Roy et al. 1994). Increased relatedness in a pack may lead to decreased genetic heterogeneity (Williams et al. 2003).

CONSERVATION

The coyote is not threatened in any part of its geographic range and is listed as a species of least concern by the International Union for the Conservation of Nature and Natural Resources. The coyote has an increasing population trend, and no legal protection covers the species (Sillero-Zubiri and Hoffmann 2004). Coyotes are considered a “nuisance” animal in Mississippi and can be hunted or trapped year-round with the proper permits (MDWFP 2008). Conflicts between humans and coyotes have increased as the population of this species expands. This population expansion may be the result of extirpation of other predators from the state (mountain lion, red wolf, black bear—Lovell et al. 1998).

REMARKS

The word “coyote” comes from the Aztec word “coyotl,” which means “barking dog.” Coyotes are also referred to as the American jackal, brush wolf, or prairie wolf.

While larger size of the coyote in the northern extent of its range may be explained by Bergmann’s rule (increased body size with increased latitude), Way’s (2007) study indicated that longitude affects size in coyotes significantly more than latitude. Way suggested a deeper genetic analysis to determine if hybridization with wolves or preference and selection of prey (feeding more on large ungulates) may be the cause of this trend.

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