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Gray fox (*Urocyon cinereoargenteus*)

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Abstract—*Urocyon cinereoargenteus* (Schreber 1775) is a carnivore commonly called the gray fox. Weighing 4–5 kg, the gray fox is 1 of only 2 species in the genus Urocyon. It occurs throughout the United States excluding some northeastern states and ranges overall from southern Canada to northern South America. Gray foxes are generally considered a woodland species; however, they also occur in areas with a mix of woods and fields and woodland/agricultural landscapes. Since the gray fox is relatively common it is not currently of conservation concern in any of its range.

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CONTEXT AND CONTENT

Order Carnivora, family Canidae, subfamily Caninae. Two former proposals by Clutton-Brock et al. (1976) and Van Gelder (1978) recommended that *Urocyon* be placed in the genus *Vulpes*. More recent studies, however, have shown that gray foxes represent a separate lineage from the vulpine foxes (Geffen et al. 1992). *Urocyon cinereoargenteus* and *U. littoralis* are the 2 species found in this family.

GENERAL CHARACTERS

The gray fox is a small- to medium-sized canid (Cypher 2003), weighing 4–5 kg. Head and body length is about 60 cm; tail length is about 30 cm. Males are generally larger than females (Sullivan 1956). Each forefoot has 5 toes with a dewclaw that can be found higher on the leg than the other toes (Cypher 2003). The hind foot has 4 toes and is 100–150 mm in length. Gray foxes have nonretractable claws.

Gray foxes display little color variation among individuals (Samuel and Nelson 1982). Their coat is peppered gray with small highlights of reddish brown on the neck, sides, and legs (Cypher 2003). This salt and pepper appearance results from white, black, and gray banding of individual guard hairs on the back and sides (Fritzell and Haroldson 1982). The underside is lighter in color with a cinnamon

Fig. 1. An adult male *Urocyon cinereoargenteus* from Washington D. C. library (WO/ 8192-003). Used with permission of the photographer Gary M. Stolz.

Fig. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of an adult male *Urocyon cinereoargenteus* (University of Michigan Museum of Zoology, 12190). Greatest length of skull is 121 mm. Used with permission of photographer Phil Myers.

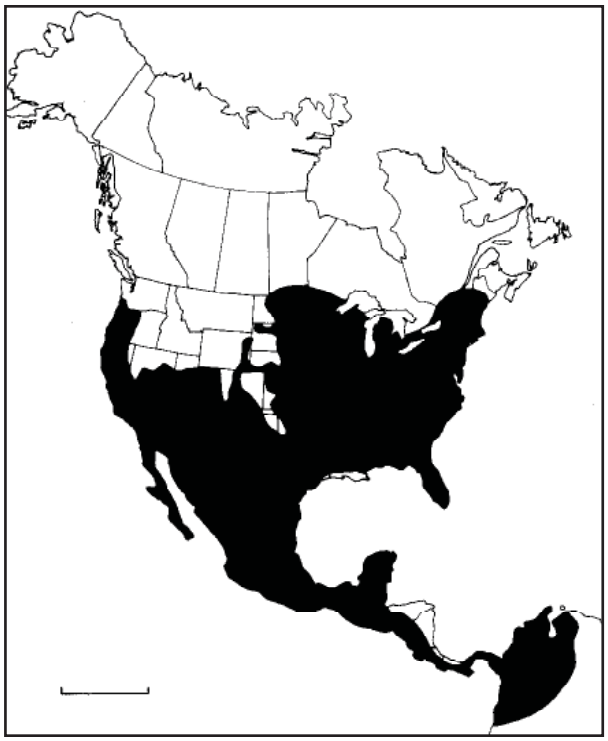

Fig. 3. Geographic distribution of *Urocyon cinereoargenteus*. Map redrawn from Hall (1981) and Fritzell and Haroldson (1982) with modifications.

appearance and some white on the throat. On the dorsal surface of the tail is a unique ridge–like section of coarse black guard hairs, which are longer than surrounding hairs. The tail and the tips of the ears are also black in color (Samuel and Nelson 1982). The ears, throat, chest, belly, and hind legs are white (Fritzell and Haroldson 1982).

The gray fox, like other North American foxes, has an elongated rostrum (Cypher 2003). The dorsal surface of the postorbital process is concave, and the sagittal crest is not prominent (Hall 1981). Average condylobasal length for 20 male gray foxes was 121.0 mm while the average length for 14 females was 117.4 mm (Grinnell et al. 1937). Average zygomatic breadth length of these same males and females was 67.9 mm and 64.9 mm, respectively, whereas interorbital width was 25.6 mm for males and 24.4 mm for females.

DISTRIBUTION

The gray fox occurs throughout most of the United States excluding parts of the northern Rocky Mountains (Samuel and Nelson 1982; Fig. 3). Gray foxes occur throughout Mississippi. Historically, the native gray fox occurred over most of eastern North America (Churcher 1959). Until the last century, the gray fox had disappeared from New England (Samuel and Nelson 1982). During a warm Hypsithermal period (5,000–2,000 B.C.), *Urocyon* moved north and east (Dorf 1959). Its range then contracted south as the weather became cooler. Other shifts in range may have occurred during another warm period (1,000–1,300 A.D.). Reentry of *Urocyon* into New England may be related to a more recent warm trend (since 1850). Gray fox were thought to have colonized the Channel Islands off southern California during the mid to late Pleistocene (Cypher 2003). These foxes now occur on the 6 largest Channel Islands and are each considered a different subspecies (Grinnell et al. 1937).

FORM AND FUNCTION

Guard hairs of the gray fox range from 50–70 mm (Fritzell and Haroldson 1982). They also have a light gray underfur, which is about 30–40 mm long. The gray fox exhibits a single annual molt that occurs from summer through autumn (Grinnell et al. 1973). The subcaudal gland on the dorsal surface of the tail is the largest of any North American canid (Fritzell and Haroldson 1982). This gland extends about one third to one half the length of the tail (Samuel and Nelson 1982). Gray foxes have 6 mammae (Fritzell and Haroldson 1982).

Gray fox possess the typical canid dental formula of i 3/3, c 1/1, p 4/4, m 2/3, 42 total (Cypher 2003). The gray fox has several adaptations that enhance climbing trees, including short legs with long, sharp recurved claws (Cypher 2003). They can also rotate their forelegs further than other canids, which may aid in gripping trees while climbing (Ewer 1973).

ONTOGENY AND REPRODUCTION

Although some polygamy may occur, the gray fox is basically monogamous (Cypher 2003). Pair bonds are usually formed between foxes, and they will remain together until one dies. Female gray foxes are also monestrous (Samuel and Nelson 1982). Courtship takes place from early fall into winter, with breeding taking place from winter to spring. Young

are born from late winter to early summer. However, the timing of these events varies within species in different locations, (earlier in the south and later in the north — Cypher 2003).

Breeding season for the gray fox ranges from January to April (Sullivan 1956). Wood (1958) found that the peak-breeding season was early February in the state of Florida, while Sullivan (1956) found it to be even earlier in Alabama. Female gray foxes breed as early as 10 months of age (Samuel and Nelson 1982), although some do not their first year. The estrus cycle for the gray fox last 1–6 days (Asdell 1964), while the gestation period ranges from 51–53 days (Sheldon 1949). During October and November, spermatozoa are formed (Sullivan 1956). Males may also breed in their first year even though their os penis is not completely ossified (Storm et al. 1976).

During mating, a copulatory tie occurs in which the bulbus glandis near the end of the penis becomes enlarged, preventing withdrawal for some period of time (Ewer 1973). Based on embryo and placental counts from 8 different studies, Fritzell (1987) found litter sizes ranging from 1–10, while 4 was the most common number reported. Gray fox pups are nearly hairless at birth and weigh about 86 g (Samuel and Nelson 1982). Lactation is energetically demanding, consequently, parturition occurs while primary prey is abundant (Cypher 2003).

ECOLOGY

Population characteristics.—Population densities for gray foxes are hard to obtain due to large ranges, secretive habits, and capture difficulty (Cypher 2003). Gray foxes also change habits both temporally and spatially (Cypher 2003), making estimations of abundance difficult. A few factors that affect population densities include habitat quality, food availability, and interspecific competition. Disease, predation, and hunting are causes for mortality in the gray fox. Golden eagles, bobcats (*Lynx rufus*), mountain lions (*Puma concolor*), and coyotes have all been known to kill gray foxes (Grinnell et al. 1937). Since they are harvested throughout most of their range, in many areas this is the primary cause for mortality (Cypher 2003).

Space use.—Gray fox home ranges vary greatly both temporally and spatially (Cypher 2003). Factors affecting home ranges include food abundance, habitat quality, interspecific competition, and presence of young. Although male ranges are usually larger than females, Chamberlain and Leopold (2000) found no difference between sexes in Mississippi. Home ranges tend to be larger in the eastern part of North America when compared to those in the west (Fritzell 1987). In Mississippi, movement rates for male and female gray foxes are greatest during the winter and pup-rearing periods, while lowest during breeding (Chamberlain and Leopold 2000).

Gray foxes occupy virtually all types of terrestrial habitat in North America (Cypher 2003). They thrive in a variety of areas including mixed woodland/agricultural landscapes in the Midwest, deciduous hardwoods in the East, along with many other types of habits in the West (Hall 1981). In Mississippi, the gray fox uses mature pine (*Pinus* spp.) forests more than expected. This may be due to food availability, including small mammal abundance (Chamberlain and Leopold 2000).

Like other species of fox, the gray fox uses a den for pup rearing. Den sites for the gray fox can be found in hollow logs, woodpiles, rocky outcrops, or brushpiles (Trapp and Hallberg 1975). They have also been found in denser cover than is usually the case with other foxes. Den sites are also commonly found near a permanent source of water (Sullivan 1956).

Diet.—The gray fox feeds on a variety of plant and animal material, including small mammals, birds, fruits, and insects (Samuel and Nelson 1982). During winter, gray foxes consume primarily small mammals; however, during spring and summer dietary breadth increases as other food items become available (Cypher 2003). Fritzell and Haroldson (1982) described the gray fox as the most omnivorous of North American fox species.

Wood et al. (1958) and Trapp and Hallberg (1975) noted that mammals consumed by gray fox included rabbits, voles, mice (*Peromyscus* spp.), woodrats (*Neotoma* spp.), squirrels (*Sciurus* spp. and *Tamiasciurus* spp.), cotton rats (Sigmodon spp.), pocket gophers (*Thomomys* spp.), and opossums (*Didelphis virginiana*). They also found that pheasants (*Phasianus colchicus*), ducks, and various passerines are sometimes prey. These studies also documented consumption of persimmon fruit (*Diospyros virginiana*), grapes (*Vitis* spp.), huckleberries (*Gaylussacia* spp.), apples (*Malus* spp.), corn, and various grains. Hockman and Chapman (1983) found that corn was the most heavily used food in the gray fox's diet in Maryland.

GENETICS

The gray fox has a diploid chromosome number of 66 with a fundamental number of 70 (Fritzell and Haroldson 1982). Autosomes include a single pair of metacentrics and 31 pairs of size–graded acro– or subacrocentrics, in which two possess achromatic regions in the long arm next to the centromere (Fritzell and Haroldson 1982). Hsu and Benirschke (1970) noted that the X chromosome is submetacentric and is the largest element while the Y chromosome is metacentric and is the smallest element.

A genetically based condition in which there is an absence of guard hairs, known as "Samson" condition, was described by Grinnell et al. (1937). In the state of New York, an albinistic gray fox was described (Shipherd and Stone 1974). There has also been one report of an *Urocyon* crossed with *Vulpes*, but the hybrid was based strictly on a pelt description by a fur dealer in Ohio (Bezdek 1944).

CONSERVATION

Gray foxes are relatively common and have little economic value (Cypher 2003). Consequently, little research has been done compared to other species of foxes. To develop management strategies, more research on ecology and demographics is needed.

The adaptability of the gray fox has allowed it to persist in areas altered by humans (Cypher 2003). This makes the protection of people and domestic animals particularly important. Therefore, ecological and demographic information is also needed for these areas where wildlife and humans coexist.

REMARKS

The gray fox is sometimes known as the tree fox. Hall (1981) notes 7 recognized subspecies: *Urocyon cinereoargenteus borealis* (New England), *U. c. cinereoargenteus* (eastern Unites States), *U. c. floridanus* (Gulf states), *U. c. ocythous* (central plains states), *U. c. scottii* (southwestern United States, northern Mexico), *U. c. townsendi* (California, Oregon), and *U. c. californicus* (southern California). Eight additional subspecies occur in Central and South America (Cypher 2003).

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