

Red Fox

Vulpes vulpes

DESCRIPTION

The red fox is a ubiquitous wild canine occurring in a variety of habitats throughout its range. Although its typical pelage color is red, the red fox also occurs in a melanistic form called a “silver fox” and with a gray and yellow mixed pelage referred to as a “cross fox.” Regardless of its color phase, the red fox can be identified by its characteristic bushy, white-tipped tail, pointed muzzle, and prominent ears.

BODY SIZE

The red fox varies in size throughout its geographic range with males typically larger than females (Lariviere and Pasitschniak-Arts 1996). In an Indiana study, male foxes (n = 195) averaged 105.2 cm in length and 4.9 kg in weight. Females (n = 126) averaged 95.1 cm in length and 4.0 kg in weight. For males and females combined, lengths ranged from 89 – 111 cm and weight ranged from 3.4 – 6.4 kg (Whitaker and Hamilton 1998). In Ontario, Canada, male foxes averaged 102.6 cm in length (n = 34) and 4.1 kg in weight (n = 37). Females averaged 97.3 cm in length (n = 34) and 3.4 kg in weight (n = 37) (Voigt 1987, as cited in Lariviere and Pasitschniak-Arts 1996).

DISTRIBUTION

The red fox is the most widely distributed carnivore in the world, occurring throughout most of Europe and Asia and in parts of Africa and the Middle East (Lariviere and Pasitschniak-Arts 1996). The species was introduced to Australia where it is now widespread. In North America the red fox is present throughout Canada and the United States (Figure 1), excluding the arctic, portions of the south Atlantic coastal region, the southwestern desert, the Pacific coastal region, and portions of the south-central Great Plains (Lariviere and Pasitschniak-Arts 1996, Whitaker and Hamilton 1998).

The red fox is native to the North American continent, but prior to the 1600’s it was either rare

or not present along the eastern seaboard. The species was introduced from England to this portion of the United States between 1650 and 1750 for the sport of fox hunting (Gilmore 1946). Both the native and introduced red fox are now considered to be the same species (Whitaker and Hamilton 1998). Competition from other wild canids, in particular the coyote (*Canis latrans*), may be one of the primary limiting factors on the local distribution of this species (Harrison *et al.* 1989, Englehardt 1986, Voigt and Earle 1983).



Figure 1. Range of red fox in North America

MIGRATION

The red fox is a non-migratory species that maintains its territory throughout the year (Voigt 1987, as cited in Lariviere and Pasitschniak-Arts 1996).

HABITAT

The red fox occupies a wide range of habitats including semi-arid deserts, tundra, farmland, boreal forests, and metropolitan areas (Lariviere and Pasitschniak-Arts 1996). The species appears to thrive in heterogeneous and fragmented landscapes as opposed to large unbroken tracts of land. Its preferred habitat is an interspersed of

forest, cropland, and pastureland (Voigt 1987, Lariviere and Pasitschniak-Arts 1996).

In Maine, the species has been found to preferentially use riparian habitats when they are available, provided coyote territories have not been established in these areas. Eighty-one percent of the locations ($n = 669$) of radio-collared foxes ($n = 11$) were < 1 km from a major river, stream, or lakeshore (Harrison *et al.* 1989). Red foxes also occur in developed areas including the outskirts of large metropolitan areas such as New York City and Boston, but are more abundant in residential suburbs than in industrial and commercial areas (Whitaker and Hamilton 1998, Lariviere and Pasitschniak-Arts 1996).

In New England, within forested habitats, red foxes may use a wide variety of forest cover types, but mostly preferred early successional stands (DeGraaf and Yamasaki 2001). Other habitats used by this species include upland fields, savannas, orchards, alpine zone, palustrine wetland systems (excluding ponds), riparian zones, coastal beaches, sand/gravel banks, and areas with exposed bedrock, cliffs, or talus (DeGraaf and Yamasaki 2001).

Availabilities of prey and suitable den sites are key factors affecting habitat selection by red fox (Whitaker and Hamilton 1998, Lariviere and Pasitschniak-Arts 1996). They prefer to locate their dens in a forest, but close to an open area, or in areas that provide thick cover (Whitaker and Hamilton 1998; Voigt and Broadfoot 1983). Typically, a den will be located on a hillside underlain by sandy loam or other soft soil, usually within 100 meters (330 feet) of a source of water (Whitaker and Hamilton 1998).

Other environmental factors such as snow depth also may affect habitat selection. For example, during the winter in Maine, red fox preferentially utilized softwood stands and open areas over hardwood forests to avoid deep or soft snow. Crusts that develop in open areas also make travel easier for foxes, but restrict prey availability. During winters with deep snow, red foxes in Maine shift their habitat use to areas with dense understory vegetation (i.e., alder thickets and

mixed or softwood stands). These habitats not only have lower snow depths, but they also support higher populations of snowshoe hare, which form a large component of the red fox's diet. (Halpin and Bissonette 1988).

In The Primary Study Area: Table 1 contains a summary of the literature review and observational data on the use by red fox of the natural community types found within the primary study area.

HIBERNATION

The red fox does not hibernate, but remains active throughout the year. Kolb (1986) found that the ranges of adult European vixens were stable throughout the year regardless of the season.

HOME RANGE AND TERRITORIALITY

An individual home range for the red fox is occupied by a single family unit composed of a male-female pair and their pups (DeGraaf and Yamasaki 2001). Home ranges of this species typically are well defined, non-overlapping and contiguous, and conform to natural physical boundaries (Sargeant 1972). In cases where home ranges do overlap, the family units may be genetically related (Voigt 1987). The red fox appears to display at least some site fidelity. Family units in Poland occupied the same territory during several winters (Goszczynski 1989 as cited in Lariviere and Pasitschniak-Arts 1996). According to Voigt (1987), home ranges in this species may be synonymous with territories because foxes actively defend their home ranges. In Maine, the average annual home range size of six adult foxes was 14.7 km^2 ($6.0 - 27.5 \pm 3.7 \text{ SE}$) (Harrison *et al.* 1989). In an Ontario (Canada) study, territory size ranged from 5 to 20 km^2 , with an average size of 9 km^2 (Voigt and Tinline 1980 as cited in DeGraaf and Yamasaki 2001). Available prey biomass and the patchiness of prey appear to affect territory size in this species (Voigt and Macdonald 1984).

At the time of dispersal, young male and female foxes have been documented to disperse more than 8 km from their natal ranges during their first year,

with distances of 24 to 32 km common (DeGraaf and Yamasaki 2001). Storm *et al.* (1976) reported mean dispersal distances of 31 km for males and 11 km for females in the Midwestern U.S. A 5-year study conducted in North Dakota found that straight-line dispersal distances ranged from 0 to 302 km, the average dispersal distance increased with the age of the fox, and males had a greater average dispersal distance than females (Allen and Sargeant 1993).

BREEDING

Female foxes typically breed the first fall or winter after their birth, but in areas with high population densities most yearling do not breed successfully (Lariviere and Pasitschniak-Arts 1996). Harris (1979) found that in areas with high fox population densities, 52% of yearling vixens did not breed. Some studies have seen a strong correlation between food availability and the number of yearling vixens that breed, while others indicate that breeding may also be limited by social behavior. Social groups in suburban London are often comprised of one dog fox and several vixens and typically only the dominant vixen breeds. In southwestern Ontario (Canada) where population levels were lower than in suburban London and family groups were generally pairs, 80 – 90% of the yearling vixens and 95% of older females successfully produced litters (Voigt and Macdonald 1984). Litter size (i.e., female fecundity) is also influenced by food supply (abundance of *Microtus* and *Clethrionomys* populations), mortality, and age of the female (Harris 1979, Voigt 1987 as cited in DeGraaf and Yamasaki 2001).

Red foxes are seasonally monogamous, although monogamy is not always exclusive (Whitaker and Hamilton 1998). They breed from mid-January to late February, sometimes extending into March. This species is monestrous and only one litter is produced per year. Young are born in late March or early April after an average gestation period of 53 days (range 51 to 56 days). Litter size can range from one to 12 with an average of four to five pups per litter (Lariviere and Pasitschniak-Arts 1996, Whitaker and Hamilton 1998, DeGraaf and Yamasaki 2001).

GROWTH AND DEVELOPMENT

At birth, the pups (or kits) weigh a little over 100 g, are lightly furred, and their eyes are closed. Their eyes open at about 10 to 12 days old and they are well-furred by that time (Whitaker and Hamilton 1998). During the first two weeks after birth, the female remains in the den nursing and providing warmth for the pups. The male brings food to the den for the vixen during this time. The pups have established a dominance hierarchy by the time they are three to four weeks old and during this time weaker individuals may die from malnutrition (Whitaker and Hamilton 1998).

By four to five weeks of age, the pups are eating solid food brought to the den by both parents. “Helper” foxes, which are usually females from a previous litter, also may help feed pups from the current litter. Kits are weaned by 8 to 10 weeks of age (Whitaker and Hamilton 1998; Sargeant 1978). The kits remain at their natal den until they are about 3.5 months old, at which time they begin to hunt for themselves.

By September, young males begin to disperse and attempt to establish their own territories. Females also may disperse or they may remain up to several years in their natal territory (Whitaker and Hamilton 1998). Allen and Sargeant (1993) found that 64% of males and only 29% of females dispersed during their first year. As the animals aged, a larger percentage of both males and females had dispersed from their parental territories.

FOOD HABITS AND DIET

Reports of food consumption for this species are variable and range from 0.38 to 0.57 kg of prey per day (Whitaker and Hamilton 1998). In one study (Sargeant 1978), captive adult red foxes required 2.25 kg of food per week. Pups 5 – 8 weeks of age, 9 – 12 weeks, and pups more than 12 weeks old required 1.38, 1.9, and 2.54 kg of food per week, respectively.

Red foxes are omnivorous and feed on a variety of prey and plant material. Their diet includes insects, small mammals (e.g., rodents and

lagamorphs), birds, turtles, frogs, snakes, fish, eggs, carrion, earthworms, berries, fruits, seeds, and garbage (DeGraaf and Yamasaki 2001). Mustelids, raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), muskrats (*Ondarta zibethicus*), deer fawns, and ringed seal (*Phoca hispida*) pups are also known to be taken by red fox (Lariviere and Pasitschniak-Arts 1996). Birds in the fox's diet include galliformes, passeriformes, columbiformes, anseriformes, and raptors (Lariviere and Pasitschniak-Arts 1996). Anseriformes consumed by red foxes include blue-winged teal (*Anas discors*), northern pintail (*Anas acuta*), mallard (*Anas platyrhynchos*), northern shoveler (*Anas clypeata*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), and green-winged teal, (*Anas crecca*) (Sargeant *et al.* 1984).

In a Maine study, scat analysis ($n = 500$) showed that the diet of the Maine red foxes include a variety of prey and plant material. Prey included snowshoe hare (*Lepus americanus*), white-tailed deer (*Odocoileus virginianus*), mice (*Peromyscus* spp.), woodland jumping mice (*Napaeozapus insignis*), southern red-backed vole (*Clethrionomys gapperi*), meadow vole (*Microtus pennsylvanicus*), short-tailed shrew (*Blarina brevicauda*), other

species of shrews (*Sorex* spp.), birds, red squirrel red squirrel (*Tamiasciurus hudsonicus*), muskrat, moose (*Alces alces*), insects, beaver (*Castor canadensis*), porcupine (*Erethizon dorsatum*), and raccoon (DiBello *et al.* 1990). It is assumed that most, if not all, white-tailed deer and moose remains present in scat were the result of scavenging activities rather than actual kills. Plant material present in the diet included blueberries (*Vaccinium* spp.), raspberries (*Rubus* spp.), pin cherries (*Prunus pensylvanica*), chokecherries (*Prunus virginiana*), serviceberries (*Amelanchier* spp.), apples (*Malus* spp.), beech nuts (*Fagus grandifolia*), and sarsaparilla (*Aralia* spp.).

The red fox's diet varies throughout the year and changes with food availability. During the winter, their diet includes mice, rabbits, birds, carrion, apples, and dried berries. The spring and summer diet includes rabbits, rodents and other small mammals, woodchucks, poultry, birds, snakes, turtles and their eggs, deer fawns, raspberries, and blackberries. Wild cherries, grapes, grasshoppers, and mice are consumed during the fall (Whitaker and Hamilton 1998). In Maine, consumption of small mammals by red foxes increases from winter to summer and from summer to fall, which

Table 1. Habitat use by red fox in the primary study area

Habitat Codes and Natural Community Classifications																				
Wetland Habitats								Terrestrial Habitats												
ROW	ROW & PAB	SHO	PFO				PSS	PEM	WM	VP	SW	MW	HW		OF	AGR	RES			
Medium-gradient stream	Low-gradient stream	Riverine pointbar and beach	Mud flat	Red maple swamp	Black ash-red maple-tamarack calcareous seepage swamp	Transitional floodplain forest	High-terrace floodplain forest	Shrub swamp	Deep emergent marsh	Shallow emergent marsh	Wet meadow	Woodland vernal pool	Spruce-fir-northern hardwood forest	Northern hardwoods-hemlock-white pine forest	Successional northern hardwood forest	Red oak-sugar maple transitional forest	Rich mesic forest	Cultural grassland	Agricultural cropland	Residential development
		Y	Y	Y	Y	Y	Y	Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	

ROW = Riverine Open Water
 SHO = Shorelines
 PFO = Palustrine Forested
 PSS = Palustrine Scrub-Shrub
 PEM = Palustrine Emergent
 WM = Wet Meadow
 PAB = Palustrine Aquatic Bed
 VP = Vernal Pool
 SW = Softwood Forests
 MW = Mixed Forests
 HW = Hardwood Forests
 OF = Open Fields
 AGR = Agricultural Croplands
 RES = Residential
 Season of Use
 B = Breeding
 M = Migration
 W = Wintering
 Y = Year-round
 Shading = observed in study area

coincides with increases in small mammal production resulting in peak populations during September and October (DiBello *et al.* 1990). In the northern prairie states, nesting dabbling ducks form a major portion of the red fox diet during the denning season (Sargeant *et al.* 1984).

Environmental conditions such as snow depth can also result in dietary changes. For example, in Maine foxes appear to eat more snowshoe hare and fewer small mammals during severe winters (Halpin and Bissonette 1988, DiBello *et al.* 1993). Diet selection can also vary with availability based on geographic location. Blueberries occurred in 74.7% of the fox scat that contained fruits in a study area that included large commercial blueberry barrens, versus 1.5% of the scats in a second study area without commercial barrens (DiBello *et al.* 1990).

Red foxes will cache surplus food under leaf litter or snow and mark the location with urine (Whitaker and Hamilton 1998, DeGraaf and Yamasaki 2001). Cashes appear to be relocated by memory and scent, but these caches may be raided by other animals.

POPULATIONS AND DEMOGRAPHY

Population Densities: Population density estimates of red fox in southern Ontario ranged from 0.1 fox/km² to 3 fox/km² depending on the habitat quality (Voigt 1987).

Age at Maturity and Life Span: Both the male and female of this species reach sexual maturity the fall or winter following their birth (DeGraaf and Yamasaki 2001). Red fox typically live between three to seven years, although they have been documented to live up to about nine years in the wild (Allen and Sargeant 1993 as cited in Lariviere and Pasitschniak-Arts 1996, Whitaker and Hamilton 1998).

Mortality: In addition to predation, other sources of mortality include trapping, hunting and collisions with vehicles. In a study conducted in North Dakota, 51% of 363 tagged red foxes were trapped, 28% were shot, and 21% died from other causes including collisions with vehicles (Allen

and Sargeant 1993). Disease also can impact red fox populations. For example, in Ontario, Canada rabies has been enzootic since 1954 and most areas experience epizootic events every three to four years (Voigt and Macdonald 1984).

Enemies: Wolves (*Canis lupus*), coyotes, mountain lions (*Puma concolor*), lynx (*Lynx canadensis*), bobcats (*Lynx rufus*), and domestic dogs (*Canis familiaris*) may kill adult red foxes (Lariviere and Pasitschniak-Arts 1996). Young foxes also are killed by a number of different mammalian and avian predators (Whitaker and Hamilton 1998).

STATUS

General: The red fox occurs throughout New England and its regional status ranges from common to uncommon (DeGraaf and Yamasaki 2001).

In The Primary Study Area: During snow tracking surveys in 1999 and 2000, fox tracks were identified at scent post stations on at least six occasions. Observations of the animals or their sign (i.e., tracks or scat) were relatively uncommon. Figure 2 illustrates the locations where red fox, or their sign, were observed in the primary study area in the course of the 1998 to 2000 field work.

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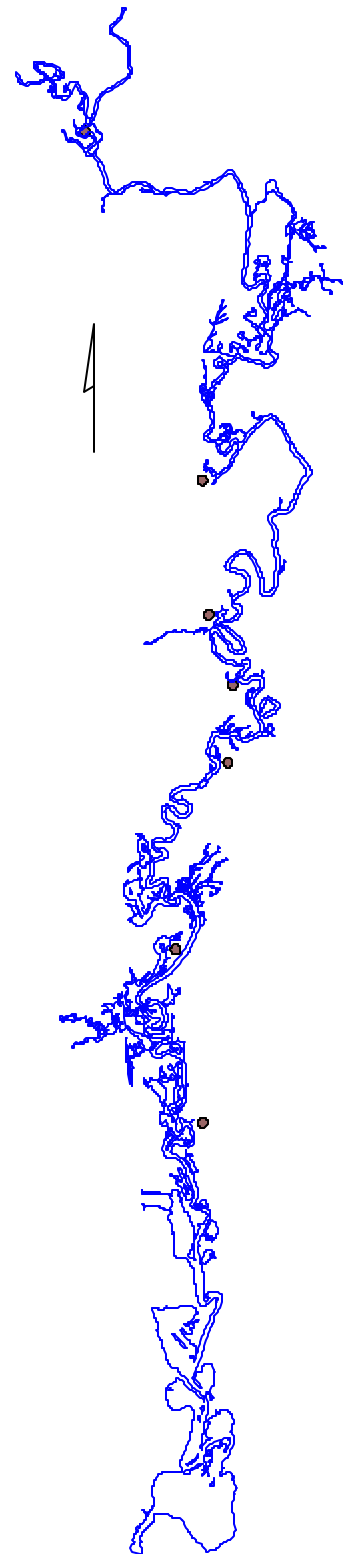


Figure 2. Red fox sightings in the primary study area

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