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URBAN FOX ECOLOGY AND MANAGEMENT TECHNIQUES

Ansley Carson Daniel, *UGA Warnell School of Forestry and Natural Resources*
Summer Fink, *UGA Warnell School of Forestry and Natural Resources*
Kaitlin Goode, *Georgia Department of Natural Resources*
Michel Kohl, *UGA Warnell School of Forestry and Natural Resources*

INTRODUCTION

There are two fox species found throughout the southeastern United States: the red fox *(Vulpes vulpes)* and gray fox *(Urocyon cinereoargenteus)*. Red and gray foxes are a part of the Canidae family. They are most closely related to coyotes, wolves, and domesticated dogs. Red foxes are the most widely distributed carnivore in the world and were introduced to the Southeast of the USA in the 1700s by Europeans for fox hunting[1]. Since then, red foxes have expanded throughout the United States and can be found in agricultural, rural, and urban environments. Red foxes are adaptable, they have a generalist diet, consisting of plants to small mammals, and non-specific habitat requirements[2]. Gray foxes are native to North America and are commonly found across the southern half of the United States. Gray foxes are highly adaptable; they live in a variety of habitats. Both species are found throughout the state of Georgia, living in urban and suburban areas[3]. Because both foxes live in the same places as humans, there are opportunities for foxes and people to interact. There are concerns about their level of danger to humans and pets. This article addresses real and perceived threats of foxes.

Image 1: ***Red Fox.*** Photo by Summer Fink

Image 2: ***Gray Fox.*** Photo by Michel Kohl

BEHAVIOR AND DESCRIPTION

The red fox is characterized by its small size (8-14 lbs.), reddish-brown and white coat pattern, black leg extremities and white-tipped tails. Males can be slightly larger than females. The gray fox is characterized by a gray and brown body, black tipped tail, and generally smaller size (6-14 lbs.) than the red fox[4].

Diet. Red and gray foxes are omnivores and eat a variety of small mammals (such as mice, voles, squirrels, and rabbits), birds, reptiles, amphibians, insects, fruit and plants. Foxes will commonly "cache" or bury excess food in shallow holes to save for later. While both species of foxes have a similar diet, there are a few key differences. Red foxes eat primarily mammals (upwards of 70% of their diet), but also eat similar amounts of birds and plants (~10% each). Eastern cottontail rabbits were at least one-third of the mammals eaten[7]. Insects become more prominent in the diet of red foxes in the summer months8. In comparison, gray fox diets consist mostly of plants (~50%) and mammals (~35%), with some consumption of birds (~10%). Both species had an increase in plant intake during the winter season, when agricultural products like corn and soybeans are readily available[7]. However, this information is from a study in Maryland because dietary information that is specific to the southeastern United States is not available. Diet of these foxes may vary in Georgia.

Life History. Red foxes typically make underground dens in January, which are generally only used when raising young. Foxes may use abandoned groundhog burrows, or dig dens under crawl spaces, junk piles, and other man-made structures in urban areas. In the spring they will give birth to 4-7 young, called kits, after a gestation period of 51-53 days. Both parents will raise the young. At 7 months old, the kits begin to disperse (~ September - October). Male red foxes disperse much greater distances than female foxes; in a study from the United States Great Lakes region, male red foxes dispersed on average a distance of 19.4 miles away from their birth location while females dispersed on average 6.7 miles[9]. Red foxes may also shift their distribution based on the season; typically, they prefer more urban environments during the winter months when natural foods are more limited and there is easy access to human-related food sources (e.g., pet food). Their home ranges were larger during the summer than in the winter in response to changing resource availability[10]. In rural areas, the average home range is about 4 square miles while in urban areas it is about 1 square mile[11].

Gray foxes have similar reproduction and dispersal habits to red foxes. The breeding season lasts from January to February, with births peaking in April. Gray foxes typically have between 2-6 kits each breeding season[12]. Rural gray fox home ranges are on average 1.9 miles[2], while in urban areas they are an average of 1.7 miles[2, 11]. Males tend to have larger home ranges than females[13].

CONFLICT

Human-wildlife interactions (HWI) can be positive (e.g., educational program), neutral (e.g., sightings) or negative (e.g., physical human contact). Most fox interactions are minor and foxes rarely pose a risk to livestock, property, pets, or human health14. Since 2019, Georgia Department of Natural Resources (DNR) Urban Wildlife Program has been monitoring HWI throughout metro Atlanta, GA by species and conflict type (Figure 1). Since the beginning of the program until the end of 2022, 61% of all calls about foxes were to report a sighting, and 30% of calls were to report a sick or injured fox (Figure 2).[15]

Sightings. As of 2020, 86% of the United States population lived in urban or suburban areas, and that number is estimated to rise within the next few years. This increase in urbanization combined with the ability of foxes to live in urban areas will lead to an ever-increasing observations of foxes in urban neighborhoods[16]. Related to that, it is important to note that although foxes are typically a nocturnal species, it is not abnormal to see them out during the daytime, especially during the breeding season (January-February) when both red and gray foxes are more active[9,12]. Sightings may also increase during the months of September and October, when juvenile foxes are dispersing from their dens[9].

Pet/Livestock Conflicts. Most fox sightings are typically not a cause for predation concern. Due to the size of foxes, attacks on dogs and house cats are extremely rare because these house pets are often the same size or larger than foxes. Studies in Missouri and New Hampshire have shown that domestic pets make up less than 1% of the red fox diet annually. Livestock such as chickens, ducks, and rabbits accounted for 7.5% of the red fox's diet in Missouri, and only 2.9% in New Hampshire[8,17]. In Maryland, domestic chickens only accounted for 3.2% of the gray fox's diet[7]. To reduce the risk of predation on pets and livestock, secure animals during the night and supervise pets while they are outside.

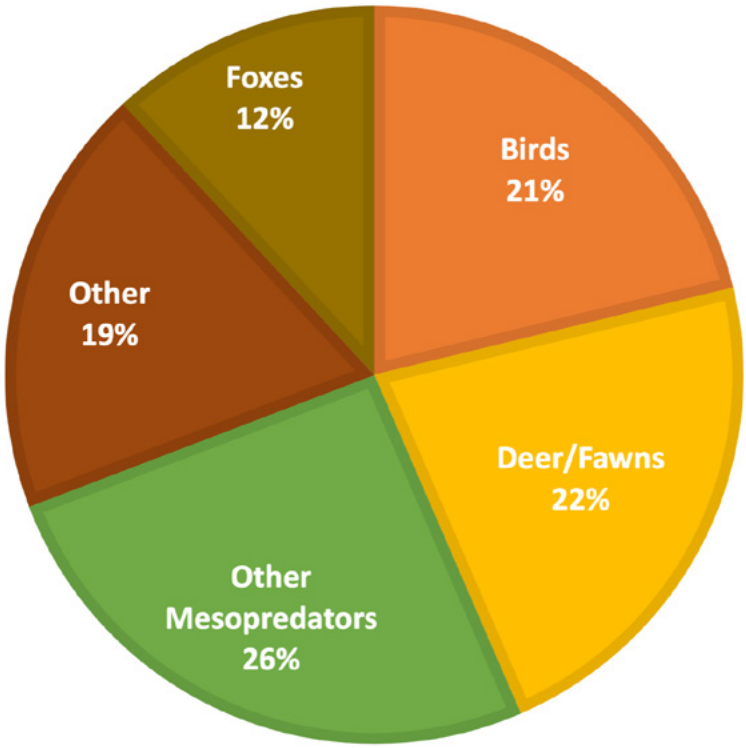

Figure 1: *Classification of reports to the Georgia Department of Natural Resources Urban Wildlife Program by species between July 1, 2019 and December 31, 2022.*

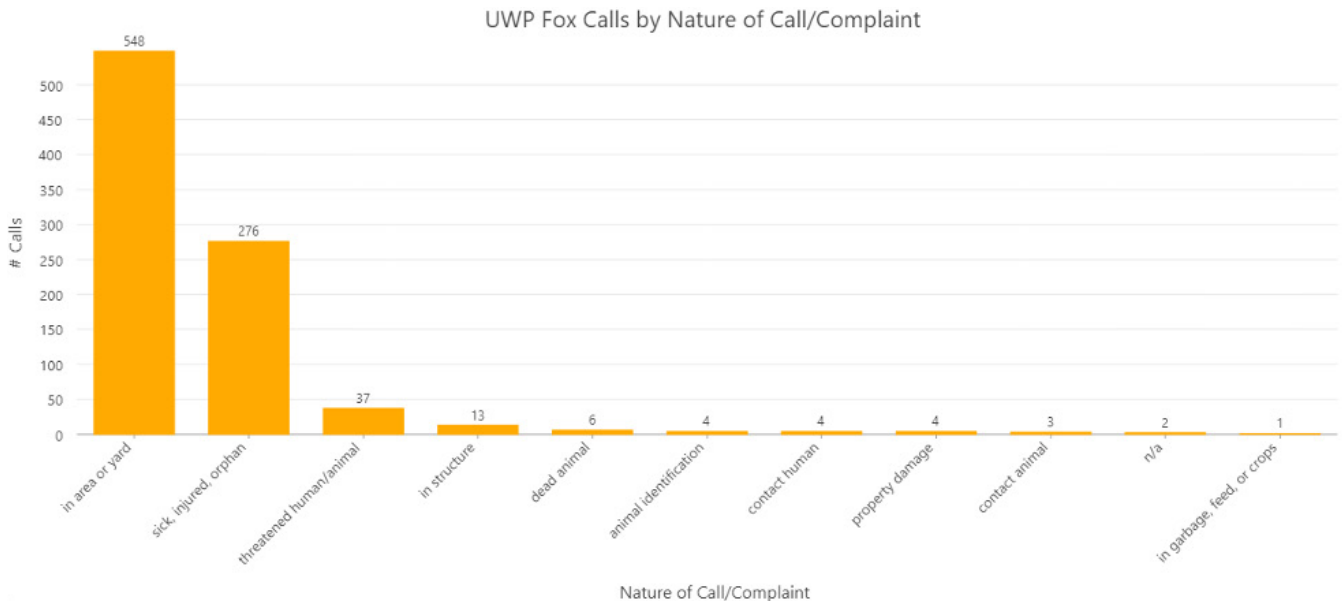

Figure 2: *Classification of reports to the Georgia Department of Natural Resources Urban Wildlife Program by species between July 1, 2019 and December 31, 2022.*

Disease. A consequence of urbanization is increased interactions between foxes, humans, and domestic pets, which can lead to increased disease transmission risk (through both direct and indirect contact)[18]. Foxes can carry mites, bacteria, and viruses that can be passed to both pets and humans, which is why it is important to be able to recognize signs and symptoms of transmittable diseases.

Canine Parvovirus (CPV). Canine Parvovirus (CPV) is a viral disease that was first reported in the late 1970s. CPV is long-lasting in the environment and can be transmitted through direct contact with urine, feces, and other bodily fluids. CPV is transmittable amongst canids, including domestic dogs. Symptoms in domestic canines and wildlife include, but are not limited to, lethargy, diarrhea, vomiting, and fever. Transmission may increase in urban areas because of increased possibilities of interaction. In Wisconsin, 53.3% of tested red foxes were seropositive for CPV antibodies, while in Pennsylvania 68.8% of gray foxes tested seropositive[18,23]. To protect your dog, vaccines can be acquired through your local vet, pet store, or community vaccine clinics.

Sarcoptic Mange. Sarcoptic mange (mange) is a very common disease found in red foxes in the southeastern United States. Clinical mange is extremely rare in gray foxes. Research has shown that red foxes in urban settings are more likely to contract mange than in rural environments[19]. Mange is characterized by loss of hair, irritated skin, severe dermatitis, and the presence of *Sarcoptes scabiei* mites. Foxes with mange will usually be lethargic, emaciated, and have a lack of fear towards humans[3]. In severe cases of mange, the exposure to the elements (e.g., cold) can lead to mortality[1]. It is important to avoid contact with foxes that you suspect to have mange because the parasite can be spread to humans (known as scabies) and domestic pets. However, there are treatments for both humans and pets. In Georgia, it is illegal to care for sick wildlife without a permit from the Georgia Department of Natural Resources. Leaving out medications for wildlife can be toxic or lethal to wildlife and other animals including domestic pets that may unintentionally ingest drugs used to treat mange.

Rabies. While red and gray foxes are rabies vector species (able to carry the disease), it is extremely rare that they do. In 2016, 313 rabid foxes were reported from across the United States (6.4% of all total wild rabies cases), which represented a 3.7% decrease in positive cases from 2015[20]. Rabies is transmitted through direct contact via saliva or brain/nervous system tissue, so a bite is the most common exposure. Although rabies is usually thought to increase aggression in wildlife, most infected animals are not aggressive and are more likely to exhibit a state of confusion, known as paralytic or dumb rabies[21]. According to the Centers for Disease Control and Prevention and Georgia Department of Health, other signs of rabies are lethargy, staggering or difficulty walking, paralysis, excessive salivation, biting at imaginary objects, and difficulty breathing or swallowing. It is important to know that you should never approach a wild animal, especially if the animal looks sick or injured. In these cases, please report the animal to Georgia DNR. It is critical to have your pets up to date on their rabies vaccines. If you or your pet is bitten by a fox, contact your local animal control office, your healthcare provider, and your veterinarian for further assistance.

Canine Distemper Virus (CDV). Canine Distemper Virus (CDV) is a virus that can infect wildlife and domestic dogs. It is usually spread through aerosol droplets; therefore, most animals demonstrating symptoms express respiratory distress such as coughing and sneezing. Neurological symptoms appear last, which can include tremors, convulsions, and disorientation[22]. Vaccinations against CDV for household pets are the most safe and effective way to protect them[23]. In Wisconsin, CDV antibodies were found in 11% of red foxes and 0% in gray foxes. However, gray foxes may have a 0% antibody prevalence rate because they are less likely to survive CDV, not because they are not able to contract the virus[24]. This is could occur because gray foxes infected with CDV are more susceptible to other diseases, such as toxoplasmosis and cryptosporidiosis[25].

MANAGING CONFLICT

Biologists and wildlife researchers are faced with new management concerns as urbanization increases. New management concerns may range from how to effectively address citizen concerns concerning foxes to how to prevent an overpopulation of the species in an urban space. Citizen perception and tolerance of wildlife has a large impact on how specific species are managed and how such management may directly affect populations. A Wisconsin-based study

demonstrated that citizens prefer to manage in such a way to avoid fox-human interactions and conflicts[26]. In these cases, management may consist of nonlethal mitigation methods or in some cases lethal control.

Nonlethal Management. Nonlethal management is the first step in mitigating conflicts. A concept known as hazing or "aversive conditioning" is a type of conditioning where wildlife are taught to avoid specific areas or associated stimuli without harming the animal. Hazing is a technique used on urban bears, foxes, coyotes, raccoons, deer, and other wildlife species. Hazing can be done on an individual or community level. Urban citizens can haze wildlife using the **SMART** method developed for the public in Denver, CO: **S**top and stand your ground; **M**ake yourself look big; **A**nnounce yourself in a strong and forceful voice; **R**epeat and reinforce; and **T**each a neighbor or friend how and when to haze[27].

Beyond hazing, physical barriers can help prevent foxes from entering unwanted areas, such as gardens, livestock pens, and homes. It is recommended that wire fences should be buried 12-24 inches below the ground to prevent foxes from digging underneath the fence. Also, wire fencing should be extended outwards forming and L-shaped footer underneath the ground a minimum of 12 inches[28,29] (Figure 3). In addition, the use repellents and/or deterrents can also be used such as chemical, visual (scarecrows, guard dogs), or acoustic (alarms etc.)[28,30]. Some methods of non-lethal removal (ex. relocation, deterring through chemicals) may not be legal in some states, so it is important to check with local and state regulations before removal.

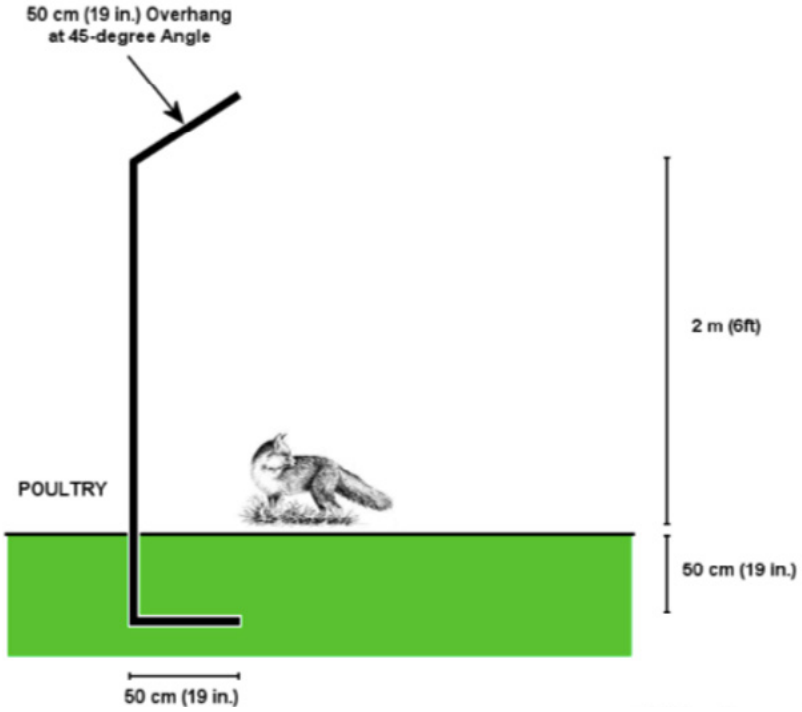

Figure 3: *Illistration of fox fencing to prevent livestock damage.*

Direct (Lethal) Management. Lethal removal is an option regardless of habituation level, however, lethal removal is only effective in resolving human-wildlife conflict issues when all other attractants are removed. If attractants are not removed from the problem area, lethal removal may only be a temporary fix until a new individual moves into the area. Examples of conflicts where the lethal removal of a problem individual may be necessary as the first step are cases of a human or pet attack.

Lethal removal of foxes may include hunting or trapping/capturing[28]. If you are trapping a fox in the state of Georgia, you must have a trapping license or landowner's trapping permit from Georgia DNR. For all other trapping rules and regulations for the state of Georgia, visit Georgia's DNR website. If you are in need of a fox removal from your property and do not have a license, there is an interactive map of licensed trappers in your area that is provided on the Georgia's DNR website.

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