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# Dogs Gone Wild: Feral Dog Damage in the United States

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**ABSTRACT** Feral dogs have been documented in all 50 states and estimates of damage in the U.S. from these animals amount to >$620 million annually. In Texas alone, it is estimated that over $5 million in damage to livestock annually can be attributed to feral dogs. We reviewed national statistics on feral dog damage reported to USDA, APHIS, Wildlife Services for a 10-year period from 1997 through 2006. Damage by feral dogs crossed multiple resource categories (e.g., agriculture, natural resources); some examples of damage include killing and affecting the behavior and habitat use of native wildlife; killing and maiming livestock; and their role as disease vectors to wildlife, domestic animals, and humans. We review the role of dog damage in the U.S., synthesize the amount of damage between resource categories (agriculture, human health and safety, disease, and natural resources), and report trends in dog damage during the 10-year period. Results showed an increase in dog damage across all resource categories indicating the importance of management.

**KEY WORDS** feral, dog, free-ranging, livestock, damage, rabies

Dogs (*Canis familiaris*) are the evolutionary descendents of wolves and through continued evolution, breeding, and adaptation have become domesticated. Archaeological specimens from Danger Cave, Utah date the history of human-dog interactions between 8,000 and 7,000 B.C.E. (Olsen 1985). Schwartz (1997) suggested that humans and dogs may have traversed the Bering Strait from Asia prior to 8,000 B.C.E. Throughout their history, humans have selectively bred more than 400 different breeds of dogs (Clark and Brace 1995).

The estimated dog population in the U.S. is 74.8 million in 44.8 million homes (APPMA 2008). However, an unknown fraction of these animals have become wild. Hereafter, we refer to wild dogs as feral. There are no reliable estimates of the number of feral dogs in the U.S., but it is generally believed feral dogs are ubiquitous throughout their range.

Populations of feral dogs are generally dependent on humans for food and recruitment. Feral dogs often rely on human refuse (Scott and Causey 1973, Gipson 1983, Daniels and Bekoff 1989), carrion from large scale poultry farms (Gipson and Sealander 1976, Mahan et al. 1978), and feedlots (Kamler et al. 2003) for food. When these food items are not readily available, feral dogs may resort to predation.

Negative impacts from feral dogs include threats to human health and safety, agriculture, natural resources, and property. Pimentel et al. (2005) estimated monetary losses to feral dogs within the U.S. at $620 million annually. In Texas alone, annual feral dog damage to livestock is approximately $5 million (Carter 1990). However, overall impacts are not well defined due to a paucity of data (Denny 1974).

Our objective was to compile and synthesize information pertaining to feral dog damage in the U.S. using data from 4 areas: 1) agriculture, 2) human health and safety, 3) diseases, and 4) natural resources. Most information was gathered from reviewing popular literature, gray literature, peer-reviewed publications, agency reports,



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and USDA, APHIS, Wildlife Services (WS) annual tables (www.aphis.usda.gov).

## IMPACTS BY FERAL DOGS

### Agriculture

Feral dog impacts to agriculture include injuring or killing livestock, damage to crops and equipment, and spreading disease to livestock. However, little is known about the role of feral dogs in spreading disease to livestock. Feral dog damage to crops and irrigation systems was reported to WS for the following: corn (Hawaii), fruit and nut trees (California), irrigation (California, Missouri), sunflower (Hawaii), and sweet corn (Hawaii, Texas), but no value estimates are available for the amount of damage. Damage to drip irrigation systems and reports of melon losses due to feral dogs have been reported to the Navajo Nation in Arizona and New Mexico.

State agriculture and wildlife agencies considered livestock damage to be the most important agricultural problem caused by feral dogs (Denny 1974). A national survey of sheep losses due to predators reported that 15.1% of all losses were due to dogs, resulting in approximately $3 million in losses in 1999 (NASS 2000). This is a 36% increase from the $2.2 million in sheep losses due to dogs reported in 1994 (NASS 1995). In 1994, the top 5 states with sheep depredation were North Carolina (100%), Maryland (100%), Virginia (95%), Michigan (81%), and Missouri (81%) (NASS 1995). In 1999, the top 5 states were Indiana (50%), Iowa (44%), Minnesota (44%), Oklahoma (43%), and Illinois (40%) (NASS 2000). In addition, 15,000 goats were lost to dogs in 1994 (NASS 1995), but goat losses dropped to 10,700 in 1999 (NASS 2000). According to WS feral dog depredation records from 1998 through 2006, 27 states reported sheep losses, 23 states reported lamb losses, 17 states reported goat losses, and 11 states reported kid goat losses. In addition, 6 states reported mohair goat losses and 4 states reported mohair kid goat losses. In Iowa (Boggess et al. 1978) and Pennsylvania (Witmer et al. 1995), 49% and 67% of all sheep losses were due to dogs, respectively. Feral dogs were responsible for 93% of all attacks on dairy goats in Louisiana (Hagstad 1987).

National surveys were conducted in 1991, 1995, 2000, and 2005 by USDA, Veterinary Services (VS) on cattle losses due to carnivores (USDA 2008); losses from feral dogs amounted to 17.6%, 16.3%, 23.8%, and 12.9%, respectively. Based on a review of cattle operations in 2005, 12–17% of animals were lost to feral dogs. However, the loss rate dropped to 5% when the number of animals increased to more than 500. Smaller farm herds are at greater risk to losses due to their proximity to human populations. The largest percentage of herd losses were in the Northeast (14.2%), Southeast (16.6%) and the South Central (17.1%) U.S. Calves lost to dogs in all operations were 18.6% in 1991, 19.1% in 1995, 16.7% in 2000, and 11.2% in 2005. In beef operations, 14.3% were lost to feral dogs in 2000 and 11.2% in 2005. Wildlife Services reported 24 states with calf losses and 20 states with cattle losses due to feral dogs.

Alternative livestock lost to feral dogs consisted primarily of llamas (*Lama glama;* Montana, New Mexico) and ratites, including ostriches (*Struthio camelus*), rheas (*Rhea americana*; New Mexico, Texas), and emus (*Dromaius novaehollandiae*). Additionally, WS received reports of losses of exotic game in 7 states. The primary farmed game species lost to feral dogs were white-tailed deer (*Odocoileus virginianus*), fallow deer (*Dama dama*), axis deer (*Axis axis*), and blackbuck antelope (*Antelope cervicapra*). Ungulates of this size readily fall prey to feral dogs.

**Human health and safety**

Bites are a common feral dog issue and account for the majority (>4 million) of all reported animal bites in the U.S. (Sacks et al. 1996). Between 1979 and 1996, 238 people died as a result of dog bites in the U.S.; one-quarter of these deaths were attributed to free-ranging dogs (Sacks et al. 2000). A recent review revealed that feral dogs cause an average of 6 human fatalities per year in the U.S. Children (32%) and older (55+) adults (47%) were the most susceptible to fatal attacks by feral dogs. The majority of victims were male (63%) which coincides with the majority of dog bite victims being male (Abrahamian 2000). The number of dog attacks is probably underreported since there is no reporting requirement and no centralized database to maintain this information.

Indirect threats of feral dogs also create problems for aviation. Dogs cause damage by digging under fences meant to keep them off runways, thus becoming a strike issue for aircraft. A Beech A-36, for example, struck a dog in Florida resulting in the loss of the aircraft (Wright 2007). Accessing the Federal Aviation Administration's (FAA) National Wildlife Strike Database (FAA 2009) revealed 28 aviation strikes due to feral dogs in the U.S. and Canada. DeVault et al. (2008) reported feral dogs as a threat to aircraft in Indiana.

**Diseases**

Feral dogs serve as vectors for diseases that can affect wildlife, humans, and livestock (Daszak et al. 2000). Dogs can carry and transmit over 40 zoonotic diseases. Infected wounds due to dog bites are polymicrobial in nature; common organisms that can be transmitted are *Pasteurella*, streptococci, staphylococci, and *Fusobacterium*, *Bacteroides*, and *Porphyromonas* species (Talan et al. 1999, Abrahamian 2000).

The primary vector for Rocky Mountain Spotted Fever (RMSF) in Arizona is feral dogs. From 2002 to 2004, an outbreak of RMSF in a rural community in Arizona resulted in 15 hospitalizations and 2 deaths (Demma et al. 2005). It has been confirmed that RMSF is now associated with a new host species, the common brown dog tick (*Rickettsia rickettsii*).

Life cycles of diseases carried by feral dogs such as *Ehrlichia* spp. and *Neospora caninum* are not well defined. *Neospora caninum*, a protozoan, has been recognized as an important cause of abortion in cattle (Anderson et al. 2000). The dog is the only species in which sexual development of *N. caninum* with resultant fecal shedding of oocysts has been demonstrated (McAllister et al. 1998, Lindsay et al. 1999). Although the discovery that the dog is a host of *N. caninum* has been a break-through, the role of dogs in the epidemiology of bovine neosporosis is still not understood, thus there is a need to be cautious when dogs are around confined feedlots and dairies.

Canine distemper virus is a highly contagious disease of dogs. This disease was also found responsible for the death of a black-footed ferret (*Mustela nigripes*) population (Williams et al. 1988). Links to dogs with canine parvovirus have been found in wildlife. For example, canine parvovirus was documented as the causative agent in the killing of gray wolf pups (Johnson et al. 1994).

Feral dogs may contract and spread rabies. In the U.S., extensive parenteral vaccination of host reservoir dog populations accompanied by control of free-ranging dogs has led to the elimination of canine rabies in dogs (Held et al. 1967). However, the canine-coyote variant of rabies reoccurred in Texas in the 1980s (Clark et al. 1994) and was subsequently translocated to Florida and Alabama causing a local outbreak in dogs (Centers for Disease

Control and Prevention [CDC] 1995). Due to an aggressive oral rabies vaccination program directed at coyotes (Sidwa et al. 2005), the canine-coyote variant of rabies has now been eliminated from the U.S. (Velasco-Villa 2008). Rabies, however, continues to be a challenge. Within tribal lands in the U.S., less than 20% of dogs are vaccinated (Bergman et al. 2008) and the majority of feral dogs are not vaccinated against any disease.

Additional threats continue to challenge the canine rabies-free declaration in the U.S. Due to the perceived good intentions of humans, dogs continue to be imported into the U.S. Many of these animals have been imported from areas where dog rabies is endemic, such as Cameroon (CDC 1987), Mexico (CDC 1988; Gomez 2007), Puerto Rico, Thailand, and India (Castrodale et al. 2008). In one recent example, a rabid dog was imported to New Jersey from Iraq in 2008 (CDC 2008). Twenty-four dogs in that shipment had also been distributed to 16 states. In 2006 alone, 287,000 dogs were legally imported into the U.S.; 25% were not vaccinated (McQuiston et al. 2008). In addition, >10,000 puppies were illegally smuggled into the U.S. through the Mexican border (Gomez 2007).

**Natural resources**

Dog use of natural areas alters both the behavior of predator and prey species. In a Colorado study, red fox numbers increased in areas of feral dog use, whereas bobcat numbers decreased due to dog use (Lenth et al. 2006). The authors also found that potential prey items such as squirrels (*Sciurus* spp.), rabbits (*Sylviagus* spp.), chipmunks (*Eutamias* spp.), and mice (*Peromyscus* spp., *Reithrodontomys* spp., *Onychomys* spp., *Zapus* spp.) were lower in areas of feral dog use.

Feral dogs have been documented killing deer in Idaho, Colorado, and Illinois (Denney 1974, Nesbitt 1975, Lowry and McArther 1978). Wildlife Services annual tables from 1998–2006 contain reports of dog predation on elk (*Cervus elaphus*), white-tailed deer, mule deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*). Additional wildlife species affected include colonial waterbirds and wild turkeys (*Meleagris gallopavo*). The Navajo Nation Department of Fish and Wildlife suspects that feral dogs are the primary reason for the reduction of deer populations in areas around reservation communities (G. Tom, Navajo Nation Department of Fish and Wildlife, personal communication).

Feral dogs can impact the genetics of wildlife such as wolves (*Canis lupus*) and coyotes (*Canis latrans*). Due to their close relationship, dogs and wolves easily hybridize (Lehman et al. 1991). There are a few cases of wolves, primarily females, interbreeding with dogs independent of human involvement (Young 1944). The most recent evidence involves two cases of dogs hybridizing with Mexican wolves, resulting in two litters of pups. Humans purposefully cross wild wolves with dogs, resulting in approximately 300,000 (Willems 1995) to 400,000 (Hope 1994) hybrids in the U.S. Other estimates suggest wolf-dog hybrid numbers to be $\leq$2 million (Kramek 1992). The offspring of the aforementioned crossings and their subsequent generations may be fertile (Iljin 1941). Some humans may release hybrids into the wild in an attempt to reestablish wolves to their historic range (Bangs et al. 1998). Further, most jurisdictions have made it illegal to vaccinate wolves or wolf hybrids, thus increasing the potential risks of rabies.

Dogs will also hybridize with coyotes (Young and Jackson 1951, Gier 1968, Silver and Silver 1969, Mahan et al. 1978). The highest ratio of dog-coyote hybrids is found

in relationship to higher human population densities (Mahan et al. 1978). Two studies reported that hybrids are more aggressive than coyotes (Gipson 1972, Fox 1975). Feral dogs have been documented killing coyotes (Kamler et al. 2003), so the outcome of dog-coyote interactions is not straightforward.

Feral dogs may impact threatened and endangered wildlife species. Wildlife Services records from 1998–2006 contain reported losses of the following threatened and endangered species due to feral dog predation: Atwater's prairie chickens (*Tympanuchus cupido attwateri*) in Texas; black-footed ferrets in Arizona; Hawaiian coot (*Fulica americana alai*), Hawaiian duck (*Anas wyvilliana*), Hawaiian goose (*Branta sandvicensis*), Hawaiian moorhen (*Gallinula chloropus sandvicensis*), and Hawaiian stilt (*Himantopus mexicanus knudseni*) in Hawaii; Mississippi sandhill crane (*Grus canadensis canadensis*) in Mississippi; and the western snowy plover (*Charadrius alexandrinus nivosus*), salt marsh harvest mouse (*Reithrodontomys raviventris*), and Mojave desert tortoise (*Gopherus agassizii*) in California.

## CONCLUSION

Feral dogs continue to be a management challenge due to the perception that they are domesticated. To the contrary, feral dogs can quite readily revert to a wild state and become a serious management problem. A centralized clearinghouse for information on feral dogs is not available, though we encourage the development of one. We have selected many of the relevant resources to provide the reader with an overview of how pervasive the impacts of feral dogs are across a broad array of resources in the U.S. The reader must be aware that some of the best information is kept by local animal control officials but is not available. With dedication, education, persistence and appropriate funding, feral dog damage can be overcome and managed appropriately.

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