DISTRICT COURT
CITY AND COUNTY OF DENVER
STATE OF COLORADO

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CITY AND COUNTY OF DENVER, a home rule municipal corporation of the State of Colorado, and JOHN W. HICKENLOOPER, as Mayor of the City and County of Denver,
Plaintiffs,

v.

STATE OF COLORADO and BILL OWENS, in his official capacity as governor of the State of Colorado,
Defendants.

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Case No: 04 CV 3756

Courtroom: 7

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**TRIAL EXHIBIT**

**Exhibit 18.** Lockwood, Randall, *The ethology and epidemiology of canine aggression*, The domestic dog: its evolution, behaviour, and interactions with people, edited by James Serpell, Cambridge University Press, 1995; republished in Animal Law and Dog Behavior, Ed. David Favre and Peter L. Borchelt, Ph.D., 1999.

# 9 The ethology and epidemiology of canine aggression

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In *Man Meets Dog* (1953), Konrad Lorenz praised the wonders of domestication that, in a few thousand years, had transformed the wolf into the docile Alsatian dog which his children could playfully and fearlessly torment. He added (p. 75):

> I have a prejudice against people, even very small children, who are afraid of dogs. This prejudice is quite unjustified for it is a completely normal reaction for a small person, at the first sight of such a large beast of prey, at first to be anxious and careful. But the contrary standpoint, that I love children that show no fear even of big, strange dogs and know how to handle them properly, has its justification, for this can only be done by someone who possesses a certain understanding of nature and our fellow beings.

Lorenz admitted in his later years that much of what he had written about dogs was simply wrong. His assumption that domestication had largely purged the wolf of the behavior that made it potentially dangerous to man was one of his more serious errors.

For many years the phrase 'dog bites man' was a cliche for an event that is the antithesis of news, largely because it is such a common occurrence. Recently, however, media around the world have given enormous attention to dog attacks. This has created the popular impression that such attacks have become more numerous or severe.

Dog bites can affect anyone, from commoners to Queen. Recent articles in the *Washington Post* seriously raised the question of whether the Royal corgis should be allowed into the United States, given their well-publicized penchant for biting. From an epidemiological perspective, dog bite *is* a problem of epidemic proportions, affecting more than 1% of the US population annually and accounting for widespread exposure to many zoonotic diseases (Greene, Lockwood & Goldstein, 1990) and more than 20 fatalities each year. Yet it is a problem that for years has been described by public health officials as an 'unrecognized' epidemic (Harris, Imperato & Oken, 1974).

Several factors have led to increased recognition of the problem. First, a growing body of epidemiological reports have clearly described the extent of the issue (Beck, Loring & Lockwood, 1975; Lockwood & Beck, 1975; Berzon, 1978; Beck, 1981; Pinckney & Kennedy, 1982; Sacks, Sattin & Bonzo, 1989). Second, there has been widespread reporting of some of the more shocking fatal dog attacks in the media. Third, a growing number of bite cases have been brought before the courts. In the US, settlements in excess of $1 million and imprisonment of dog owners on charges of manslaughter have not been uncommon. Finally, a significant proportion of fatal and severe bites have been attributed to a relatively small number of breeds including pit bulls and Rottweilers. This has resulted in highly publicized efforts to restrict such breeds, with resulting conflicts between dog owners and authorities.

This chapter will first review the natural history of canid aggression, and some of the biological factors involved in bite incidents. It will then consider the general epidemiological findings for non-fatal attacks and recent dog-bite fatalities. Finally, some possible solutions to this problem will be proposed.

## Why canids bite

Biting is obviously a key component of predatory behavior in canids. However, most social canids show surprisingly low levels of intra-specific aggression. Despite the strong restraint on the use of aggression, biting can occur in many contexts including expressions of dominance, territorial defense, food-competition, protection of young or other pack members, pain-elicited aggression and fear-elicited aggression. Dog attack can occur in any of these contexts, and may also involve components of inter-specific predatory behavior.

It is important to recognize that artificial selection, which has resulted in the production of various breeds of dogs, frequently produces exaggerated physical or behavioral characteristics that would be maladaptive in free-living wild canids. For example, racing breeds such as greyhounds and whippets can outrun most wolves, yet the changes mankind has produced in these animals would render them virtually helpless in the world of the wild wolf.

A major human objective in the production of dog breeds has been the creation of animals more aggressive than their wild ancestors. This has been done to provide protection through inter-specific aggression (e.g. most guarding breeds) or for 'entertainment', in the form of the heightened intra-specific aggression of fighting breeds, including 'pit bull' type dogs.

Although for practical reasons there have been no comprehensive studies of the biology or ethology of fighting breeds, several biological trends have been

suggested by veterinarians called upon to treat fighting animals, as well as the experiences of myself and Humane Society field investigators in working with several hundred such animals seized in actions against illegal dog fighting.

Scott & Fuller (1965) reported a genetically based decrease in the latency to show intra-specific aggression in terriers. This simply confirmed a characteristic long-associated with such breeds. Within fighting breeds this characteristic can be even more exaggerated. Among dog fighters, an animal's tendency to attack other animals, despite fatigue or injury, is termed 'gameness'. It is a quality that is strongly selected for by breeders within the 'sport', but which has not been subjected to any formal genetic analysis.

Fighting breeds also appear to have a much higher tolerance of pain, which may be mediated by peculiarities in neurotransmitters or opiate receptor sites. A single anecdotal report of unusual responsiveness to morphine and naloxone in a pit bull (Brown *et al.*, 1987) suggests that there may be physiological differences in the breed, although no definitive studies have been reported in the literature.

In addition to a lowered threshold for attack and higher pain thresholds in many fighting animals, selection for fighting has apparently resulted in the disruption of normal communication in individuals from recent fighting lineages. Under natural conditions, the aggression of wild canids is held in check by a detailed set of postural and facial signals that clearly indicate mood and intent (Fox, 1971*a*; Schenkel, 1967). In addition, aggressive encounters are normally ended rapidly when one individual emits the appropriate 'cut-off' behavior, such as infantile vocalizations (whining, yelping) and submissive displays (Fox, 1971*b*). Dogs from fighting lineages have been under selective pressures that suppress or eliminate accurate communication of aggressive motivation or intent. It is to a fighting dog's advantage for its attack to be unexpected. Many accounts of such attacks on people note that the incident occurred 'without warning'. Similarly, once initiated, such attacks are often not ended by the withdrawal of the opponent or the display of species-typical submissive behavior. Combat involving fighting dogs can continue for several hours and separation of the animals may require the use of a 'parting stick' to physically pry the animals apart.

The extent to which such characteristics are genetically determined within the fighting breeds has been the subject of considerable controversy (Lockwood & Rindy, 1987; Clifford, Green & Watterson, 1990). Although complex behaviors such as pointing, retrieving, herding and livestock guarding are generally accepted to have a strong genetic component, many fanciers of the fighting breeds attribute the comparatively simple lowering of the threshold for aggression to purely environmental influences of irresponsible owners.

It is also important to distinguish between selective influences on inter-specific vs. intra-specific aggression. Dog fighters and advocates of fighting breeds note that, historically, fighting animals that showed aggression to people were generally removed from the gene pool, either by being destroyed or being deemed unsuitable for breeding. It is true that contemporary dogs still employed in fighting are often easily handled by others (such as Humane Society investigators). However, there is no indication that the same selective pressures are in operation since there is currently a market for even the most intractable animals in the guard dog trade.

Clearly, genetic history can influence aggressiveness of breeds and individual dogs, either increasing or decreasing these tendencies. Throughout the history of dogs, many breeds such as the Irish wolfhound and Great Dane have earned a reputation for ferocity, only to become far more docile as trends in breeding shift. Indeed part of the problem with the 'pit bull' controversy is that the lineages of fighting and non-fighting animals within the fighting breeds have been separated for many generations, but have shown relatively little physical divergence. As a result, an American pit bull terrier from recent fighting stock may be physically indistinguishable from an American or English Staffordshire (bull) terrier 50 generations removed from the fighting pits, yet the two animals could be behaviorally very different.

Selective breeding can increase or decrease the tendency for dogs to bite in different contexts. Since the level of aggressiveness can be affected by several factors with likely genetic influence, including basic temperament, timidity and the presence of painful genetic disorders, it is possible for the *lack* of any directional selection in breeding to produce an increased tendency toward aggressiveness. For example, genetic factors underlying fearfulness may

increase the likelihood of fear-biting. Other genetic factors contributing to painful congenital physical defects could increase pain-elicited aggression. In the United States at least 50 000 dogs are produced each year in 'puppy mills' for the mass pet trade. Usually the most popular breeds are represented in these intensive breeding operations and any animals of the desired breeds capable of producing young are likely to be bred and sold, regardless of temperament. The result has been the proliferation of physically and behaviorally unsound animals from among the most popular breeds, including those not traditionally associated with aggression to people, such as cocker spaniels, golden retrievers, malamutes and Siberian huskies. This problem has been widely documented in the American media (see Anon., 1990).

Any or all of the influences outlined above can help to account for biological predisposition of a dog toward aggression. Additional biological factors that can influence the tendency toward aggression include the animal's age, sex, reproductive status (intact vs. spayed or neutered) and overall health. However, the likelihood that a particular individual will bite is also strongly influenced by many environmental variables including the training of the animal, the extent of its socialization to people (especially children), the quality of the animal's supervision and restraint, and the behavior of the victim (Lockwood, 1986). This multiplicity of interacting factors in dog bite makes it difficult and often meaningless to base predictions of a particular animal's aggressive behavior on a single characteristic, such as breed.

## The epidemiology of dog bite

Having reviewed the factors that can contribute to a dog-bite incident, let us briefly examine some epidemiological findings surrounding this problem. In the United States there is no centralized record-keeping of dog-bite incidents. Communities vary widely in the extent to which these cases are investigated and bites are generally vastly under-reported (Jones & Beck, 1984). However, a general picture of bite epidemiology has emerged from a number of comprehensive surveys including Beck *et al.* (1975), as well as reports from local animal control agencies (Miller, 1986; Moore, 1987 *in lit.*; Oswald, 1991). Additional insights can be obtained from press accounts of dog bite incidents (Lockwood & Rindy, 1987) and the study of the 'worst-case' scenarios, those attacks which involve human fatalities. An overview of such attacks in the last decade is provided by Sacks *et al.* (1989), and in-depth analysis of a smaller number of incidents is provided by Borchelt *et al.* (1983). I will also review the most recent evidence from the Humane Society of the United States (HSUS) investigations of 37 fatal dog attacks occurring during 1989 and 1990.

## The victim

### *Age of victim*

Dog bite is a health problem that disproportionately affects children. Beck *et al.* (1975) found that 38% of reported bites in St Louis involved children under nine, who constituted only 15% of the population. Adults over 50 comprised 30% of the city's population, but only 11% of the bites. All other studies show a similar overrepresentation of young children among bite victims.

Fatal attacks show a bimodal age distribution, affecting the very young and the very old. Of the 157 victims of fatal dog attack reported by Sacks *et al.* (1989), 70% were under ten years of age and 22% were less than a year, while 21% were over 50. In the 1989 and 1990 cases, 60% were under five and 25% were over 72. Most of the victims falling outside of these age ranges were in some way debilitated, including one acute alcoholic and another victim attacked while having a seizure. It is interesting to note that this pattern of attacking the very young, the very old, and the infirm is consistent with the usual selection of 'prey' by wild canids, although predation was not considered a primary motivation in many of these incidents.

### *Sex of victim*

Non-fatal dog attack is disproportionately directed against males. In the Beck *et al.* (1975) survey, 65% of the victims were male. Moore (1987 *in lit.*) reported 59% of bite victims in Palm Beach County, Florida, were male. There is no consistent pattern in the case of fatal attacks. Pinckney & Kennedy (1982) reported only 33% of the victims of fatal dog attack to be males in their review of cases from 1975–90. In Sacks *et al.* (1989) 60% of the victims during 1977–88 were male, while HSUS 1989–90 data indicated 48% male victims. This variability may be due to the

fact that the majority of fatal dog attack victims are young infants whose behavior played a less important role in the attack than in the far more numerous non-fatal attacks on older children.

*Activity of victim*

Under principles of Common Law there is the assumption that dogs are harmless unless they have previously demonstrated a vicious propensity. This often leads to the related assumption that victims of dog attack have provoked or otherwise precipitated the attack. However, those studies that have attempted to document the context in which an attack has occurred generally show that bite victims are rarely engaging in activity that could legally be considered provocation (i.e. teasing, tormenting or causing physical injury to the animal, or attempting to commit a crime). In the non-fatal bites surveyed by Beck *et al.* (1975) the victims had no interaction with the dog, or were walking or sitting in 75% of the cases. In 9.6% of the cases, the victim was playing with the dog and in only 6.5% of the cases could the victim's behavior be classified as provocation.

Lockwood & Rindy (1987) compared contexts reported in press accounts of non-fatal attacks by pit bulls ($N = 101$) and all other breeds ($N = 62$). In the pit bull incidents, 58% of victims were walking or had no interaction with the dog prior to attack, 19.8% were bitten coming to the aid of a person or animal that had been attacked, 7.9% were playing with the animal and 5% were provoking the animal. In the cases involving all other breeds, 48.4% involved no direct interaction, 27.4% play and 1.6% provocation.

In their report on fatal attacks, Sacks *et al.* (1989) did not provide details of victim behavior prior to the bite, but they noted that 6.9% of these incidents involved attacks on sleeping infants. The HSUS analysis of 1989–90 fatalities found 20% of the incidents involved attacks on sleeping infants, 43% occurred while the victim was walking near the dog, 30% involved play and 6.7% provocation (victims attacked during commission of a crime).

## The dog

*Number of animals*

Most epidemiological reports do not mention the number of animals involved in non-fatal attacks. It is likely that most of these involve a single dog. Earlier investigations of dog-bite fatalities suggested that these severe incidents were more likely to involve packs of animals (Borchelt *et al.*, 1983). Recently the majority of fatal attacks have involved a single, usually large, animal. Sacks *et al.* (1989) reported that 70% of the fatal attacks from 1979–88 were by individual dogs, 20% were by two and 10% involved groups ranging from 3 to 22. The 1989–90 incidents follow an identical pattern.

*Ownership of animals*

The popular perception of dog bite is that it is largely a problem caused by stray dogs. Beck *et al.* (1975) pointed out the important distinction between problems caused by true strays (i.e. ownerless or feral animals) vs. *straying*, unrestrained owned dogs. Of the biting animals in that survey, 14.5% were considered stray, 5.9% were owned by the victim or victim's family and the rest were otherwise owned. Sacks *et al.* (1989) identified 70% of the dogs involved in 1979–88 fatalities as owned pets and 27% as strays. In its investigations of 1989–90 incidents, the HSUS made a greater effort to locate owners of the dogs in question for the purposes of filing criminal charges where appropriate. Of the 37 dogs in these cases, 51% were owned by the victim's family and 37% by a friend or neighbor. Only one animal (3%) was a stray with no known owner.

*Restraint*

Although many bites are attributed to dogs running loose, animal control officers frequently comment on the role of chaining or other restraint in producing an animal that is actually more likely to bite. Such an animal might already have a predisposition to bite (and is therefore chained), but this may only exacerbate the situation by removing opportunities for socialization and by aggravating frustration, defensive aggression and other undesirable behavior.

None of the major epidemiological surveys comment on the nature of the restraint of dogs in non-fatal attacks. In the Lockwood & Rindy (1987) survey, 42.7% of the cases of pit bull attacks involved animals that were fenced, chained or inside prior to the incident. Another 14% involved the dogs jumping fences or breaking chains. For bites involving other breeds, 26.7% of the animals were similarly restrained but only 1% involved breaking restraint.

Sacks *et al.* (1989) reported that 28% of the animals in the fatal attacks they studied were chained at the time. Of the dogs involved in fatal attacks during 1989–90, 26% were chained, 32% in the house and 32% running loose.

### *Sex and spay/neuter status*

Since much canid aggression is under hormonal influence, and since animal control agencies make spaying or neutering of pets a significant priority, it is important to attempt to get evidence on the reproductive status of animals involved in attacks. Serious dog bite seems to be a phenomenon primarily associated with male dogs. In the Beck *et al.* (1975) survey, 70% of the biting animals were male. Moore (1987 *in lit.*) was able to collect more detailed information on biting animals, recording information on breed, sex and reproductive status. Overall, 87% of all biting animals in that survey were males and 60% were unneutered males. Of the remaining 13% of bites attributed to females, half were by unspayed females. These statistics varied somewhat with breed. The breeds most frequently associated with bites also had the highest proportions of bites attributed to males (German shepherds, 86%; pit bulls, 90%; chow chows 92%; and Rottweilers, 98%).

### *Breed*

From an epidemiological perspective, it is difficult to draw scientifically sound conclusions about the relative dangers posed by different breeds. Accurate breed-specific bite rates are hard to obtain. Such statistics require good information for both the numerator (number of bites attributed to a particular breed) and the denominator (number of animals of that breed in the population). This requires comprehensive reports of all bites, reliable breed identification, and detailed information about the demographics of the entire dog population of the area in question. Such numbers are often unreliable since compliance with local dog licensing or registration requirements is usually below 20% in most US communities.

Several epidemiological studies attempted to draw some attention to breeds apparently associated with higher risks. Pinckney & Kennedy (1982) attempted to compute breed-specific bite rates using relative numbers of animals of different breeds registered with the American Kennel Club to compute the denominator, a procedure that is unlikely to reflect the overall United States dog population (Lockwood & Rindy, 1987).

Others have attempted to compute rates based on local registration, licensing or impound figures that are incomplete, but which should more accurately reflect breed representation in local populations. For example, Berzon (1978) reported that German shepherds made up 45% of the dogs listed in Baltimore bite reports, yet comprised only 23% of the animals registered in the city. From Miller (1986) it is possible to compute an index of the extent to which the representation of various breeds in the population of biting dogs in that area (Pinellas County, FL) deviates from their representation among the animals registered in that region. The breeds showing the greatest over-representation in the bite population were pit bulls (17.8% bite population and 3.7% of overall population = 4.81×), chow chows (2.43×), German shepherds (2.02×) and Dobermans (1.37×).

A similar analysis is provided by Moore (1987 *in lit.*), who used registration data to compute the percentage of the registered population of various breeds that are involved in bites. The highest rankings in that survey were pit bulls (12.3%), chow chows (11.4%), German shepherds (6.5%), Dobermans (4.3%) and Rottweilers (4.1%).

The relatively small numbers of animals involved in fatal attacks does not lend itself to this kind of bite-rate analysis in the absence of any national census on dog population. However, the patterns that emerge are consistent with the above findings. Sacks *et al.* (1989) reported that, of the 101 animals in their survey for which breed could be determined, pit bulls and pit bull mixes comprised 43%, German shepherds and shepherd mixes 15%, Siberian huskies, malamutes and mixes 18%, Dobermans 5%, Rottweilers 5% and wolf–dog hybrids 5%. The HSUS analysis of the 39 animals involved in fatal attacks during 1989–90 showed pit bulls and mixes comprised 25.6%, German shepherds and mixes 17.9%, Siberian huskies, malamutes and mixes 15.4%, wolf–dog hybrids 10.2% and chow chows 7.7%. All of these figures are likely to be significantly greater than their representation in the overall dog population of the United States.

## Conclusions

Although dog bite is a serious public health problem, it is important to remember that such encounters

represent a very small fraction of the hundreds of millions of human–dog contacts that occur each day, most of which are deeply enjoyed. Likewise, the HSUS's focus on the small fraction of dogs implicated in human fatalities should not obscure the fact that these 20 or so animals involved in such attacks each year represent an infinitesimal portion of the American dog population, less than .00004%! The proportion of American humans who kill other human beings is more than 200 times this fraction.

Humankind has made the dog in its image and, increasingly, that image has become a violent one. The breeds of dogs that have been chosen to reflect our aggressive impulses have changed over the millennia. In the last 20 years the choice has moved from German shepherds, to Dobermans, to pit bulls, to Rottweilers to a current surge in problem wolf–dog hybrids.

Problems of irresponsible ownership are not unique to pit bulls or any other breed, nor will they be in the future. Effective animal control legislation must emphasize responsible and humane ownership of genetically sound animals, as well as the responsible supervision of children and animals when they interact (Lockwood, 1988). I believe this can be encouraged in several ways:

1 By strengthening and enforcing laws against dog fighting and the irresponsible use of guard and attack dogs.
2 By eliminating the mass-production of poorly-bred and unsocialized animals in large-scale 'puppy mills'.
3 By introducing and enforcing strong animal control laws that place the burden of responsibility for the animal's actions on its owner.
4 By encouraging programs that educate the public about responsible dog ownership and the problems of dog bite.

It is possible to protect the health and safety of the public and at the same time preserve the rights of responsible dog owners. By placing greater emphasis on responsible and humane animal care, we can go a long way toward solving these problems and preserving the special human–dog relationship that has developed over thousands of years.

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