Brucellosis—A Range Livestock Problem

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Range managers involved with the movement of livestock, especially across state lines, are aware of the existence of animal health regulations governing the disease brucellosis.

Brucellosis is a highly contagious disease primarily affecting cattle, goats, sheep, and swine with occasional transmission to man. In humans, the disease is known as undulant fever, Malta or Mediterranean fever, or Bang's fever. Brucellosis is a bacterial disease attributed to *Brucella abortus* in cattle, *B. melitensis* in sheep and goats, and *B. suis* in swine. Common names of brucellosis infections include Bang's disease, contagious abortus, infectious abortus, enzootic abortus, and "slinking of calves". In cattle, the disease is characterized by premature expulsion of the fetus (abortion), retention of the placenta, and infertility. Transmission to man is usually via the form that infects cattle, but the others may also infect man.

The first clinical report of the disease in man was described by Hippocrates in the fifth century B.C. In the 15th century, brucellosis was common in Spain and was brought to the New World by the Spaniards. One chronic sufferer was the French Emperor, Napoleon Bonaparte. He suffered from recurrent fever, which may have been one of the major obstacles for his failure to win at Waterloo. He was concerned about his health and gave instructions that an autopsy be made after his death. The autopsy showed large amounts of arsenic in his body and it was concluded that the cause of death was poisoning. Napoleon was a compulsive arsenic eater and may have found that the arsenic relieved some of his problems. Several years later, a conclusive diagnosis of Malta fever (brucellosis) was made.

Diseases resembling brucellosis commonly occurred in the Mediterranean area. Malta was an important location for the spread of brucellosis during the Crimean War. It was not until early in the 19th century that the cause was isolated. In 1886, Sir David Bruce, after whom the *Brucella* organisms were named, isolated the bacteria *Brucella* and named the organisms *Micrococcus melitensis.*

Nature and Epidemiology of the Disease

Brucella infections are known throughout the world, but are most common in cultures where livestock husbandry is an important aspect of society. The chances of humans acquiring the disease depend on the level of personal contact with infected animals. Farmers, slaughterhouse workers, and veterinarians are high risk occupations for this disease. Formerly, the most frequent means of infection was from the consumption of non-pasteurized raw milk from infected animals. It was estimated, before the widespread testing of cows and pasteurization of milk, that 10 to 15 percent of the American population was infected. Now the disease is so infrequently encountered among Americans that it may not be diagnosed easily.

The current status of brucellosis infections in man is difficult to determine. Not all governments require physicians to report cases of infectious abortions to public health authorities. In the United States, human brucellosis is a reportable disease in every state except Nevada. Knowledgable experts believe that the occurrence of the disease in humans is 25 times more prevalent than reported because of misdiagnosis or underreporting.

It was estimated in 1949 that five percent of the adult cows in the United States were infected with brucellosis. These infected animals occurred in 20 percent of the cow herds in the nation. In addition, one to three percent of all swine were infected. In 1960, The U.S. Department of Agriculture reported that of the 1,146,811 cattle tested, only 1.1 percent of the cattle were infected. Since then all states have established brucellosis eradication programs.

Currently, there are 24 states in the nation that are certified free of brucellosis. Arizona, Idaho, Illinois, and Iowa are among the states who have set goals of eradication by 1988. Nevada has set the goal of being brucellosis-free in 1989. It is estimated that 70 percent of the remaining infected herds in the United States occur in Texas, Louisiana, and Florida.

The various species of *Brucella*, which are small, gram-negative, non-mobile, non-sporing, coccobacilli, are divided into types based on their biochemical, serological or metabolic characteristics. The various species and forms of *Brucella* are always interacting to form new strains which may differ in virulence to the different susceptible species. *Brucella neotomae* is found only in desert wood rats in contrast to the widespread distribution of other species in the genera.

Mode of Transmission

In cattle, the most common source of infection is from the infected discharge of pregnant animals at the time of abortion. The bacteria can be transmitted by forage that is consumed soon after contamination. Brucellosis usually spreads quite rapidly through susceptible herds. Cattle that are infected with brucellosis are usually difficult to breed, give birth to weak calves, or retain placentas even if abortion does occur. It is estimated that infected cows

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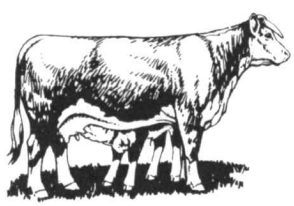
have 20 percent lower milk production and 40 percent fewer calves than brucellosis-free herds. The detection of infected herds is difficult because of the long and variable incubation period from infection to when the symptoms become apparent. A positive reaction to a blood test for brucellosis is usually evident 60 days after infection, but abortion may not occur for one to four months after mid-gestation exposure. The general mode of transmission from animal to human occurs either by direct contact with the infected tissue or through ingestion of contaminated milk or milk products. Respiratory spread, through inhalation of contaminated dust or droplets, has also been suggested as possible among laboratory workers.

The signs and symptoms associated with brucellosis are variable and depend on the clinical stages, the organ system affected, and the species of *Brucella* causing the infection. The signs and symptoms of acute human brucellosis are malaise, chills, night sweats, weakness, fatigue, and weight loss. In chronic brucellosis, intermittent malaise and a low-grade fever persisting over a period of weeks, months, or years are the most common complaints. The skeletal system is the most common site for complications to occur. Severe pain of bones of the lower extremities, arthritis, and small joint abscesses are usually very common. The nervous system and the cardiovascular system are the next most common sites that are involved. Pulmonary brucellosis may also occur and is expressed as bronchitis, pneumonia, emphysema, or lung abscess. Other organs and systems involved include the spleen, the skin and soft tissues, the eyes, and the hematopoietic system.

Of the *Brucella* species, *B. melitensis* is the most virulent, invasive, and has the highest chance of producing additional complications at the rate of about 10 to 35 percent. *B. abortus* has less frequent complications. *B. suis* has a tendency to cause chronic illness and destructive lesions, while *B. neotomae* is found only in the desert wood rat and has not caused any known complications to humans.

Infection in Wildlife

Brucellosis is a continuing economic and public health problem. As a result, increasing work and studies are being made to determine the actual impact or effects of brucellosis in wildlife. The importance of this problem is probably best exemplified by the relationship of wild animals with cattle. Some believe that wildlife have no significant role in the epidemiology of *Brucella abortus*. However, several extensive serologic and bacteriologic studies have identified potential sources of infection among wild animals.



In 1930, *Brucella abortus* was found from an enlarged testis of an American bison. Several studies have also proven that elk were susceptible to *Brucella abortus*. In a serological examination of 1,165 elk in Wyoming, 307 of the animals reacted positive to brucellosis. Abortions, birth of premature and nonviable calves, hygromas, and synovitis in the limbs were some of the clinical evidences of brucellosis in the artificially and naturally infected elk. However, results and comparisons of various serological tests on elk sera have provided inconsistent results.

White-tailed deer and the mule deer have also been reactive to brucellosis serological tests. It is assumed that *Brucella abortus* is probably the infecting organism affecting the deer population. *Brucella abortus* is the only species that has been found infecting deer species in the United States.

A number of studies have also shown that rats have contracted brucellosis through ingestion of infected material. One study suggested that the infectious agent comes from the rats excreta and can be transmitted among the rats after contact exposure. *Brucella abortus* was present in several house mice, while *Brucella neotomae* have been demonstrated to be present in the desert wood rats. In addition, all areas from which *Brucella neotomae* has been isolated have also caused other animals to be seropositive.

Another possible reactor to brucellosis in some regions is sheep. Sheep that were grazed up to 6 months annually in many of the areas where wildlife tested positive for brucellosis have tested positive for *Brucella*. The close proximity of sheep to wildlife allows excellent opportunity for contact. This transmission can occur through parasites, infected pastures and trails, infected drinking water, and through excreta of all types from the sheep.

Several methods of transmission of *Brucella* among wildlife has been proposed. Fleas from the infected wood rat indicate that the arthropod-like fleas may be involved in the role of transmission. Infection may also come from ingestion of infected carcasses. For example, white mice, deer mice, and wood rats have been infected in the laboratory after having fasted and allowed to feed on mice killed after 8 days of being infected. A third possible mode of transmission might be the ingestion of aborted fetal or placental material. All these possible modes of transmissions should receive more serious attention and further studies are needed.

Diagnosis

The most accurate method of diagnosis of brucellosis is through isolation of the *Brucella* organism. This is usually done through microbiological examination of specimens from suspected animals. A positive result can usually prove the presence of the disease in a herd.

Cattle that are diagnosed as infected with brucellosis must be sold for slaughter. The exposed herd must be quarantined until repeated testing show the remaining animals are free of the infection. A state or federal veteri-

nary officer works with the rancher until the infection is eliminated.

Recently, the federal government proposed withdrawing much of the funding for the brucellosis program in 1990. This forces the remaining states with the disease to itensify eradication programs or face possible restrictions from their disease-free neighbors.

Prevention and Control

Because of the economic losses to the livestock industry and the public hazard, it is necessary to actively control the occurrence of brucellosis in animals. There are two basic methods for controlling the disease: isolation and slaughter of animals with the disease and immunization by vaccination with live strains of *Brucella*.

It is recommended that female calves from 4 to 12 months old be vaccinated with strain 19 vaccine in areas of high infection rate. This vaccine is a lyophilized agglutinogenic strain of *Brucella abortus*. The U.S. Department of Agriculture is in charge of maintaining the strain 19 vaccine and providing culture stocks. In 1987 a total of 9.1 million calves were vaccinated.

The individual state governments maintain various forms of control over the importing of breeding cattle. Usually a brucellosis test within 30 days of the date of movement across state lines is required. Some states may not allow the importing of animals from herds that have been quarantined in other states even if they pass the brucellosis test. The best form of enforcement of laws and regulations concerning brucellosis is for informed ranchers to be aware that they are protecting their own investment when they adhere to the regulations.

In human populations, the pasteurization of milk is one of the best means of preventing human brucellosis. Veterinarians, farmers, and meat packers should observe strict rules of sanitation. There is a real need for public awareness for all aspects of the brucellosis problem, because there is always the possibility for modification of the organism, resulting in an explosive outbreak of the disease and thus becoming a problem to livestock producers as well as a continuing threat to public health.

Changes from Free to Fee Hunting

Delwin E. Benson

The issue of managing for wildlife and natural resource values on private and public lands is a growing concern. Sport hunting is a common denominator for interaction among landowners, users, and resource managers. Hunting can provide an income from the land, serve as a population regulation tool for large animals, and provide for recreation and food supply.

Private lands produce and maintain game animals. Landowners are asked to share their property rights with hunters as recreational demands increase. The idea of hunting on private land with no access costs is changing to paying for access privileges.

There is also a growing interest about charging for hunting (and other recreation) on public lands. Big game hunting, especially, represents a value of public lands where large sources of biomass (animals) are produced and removed without commensurate generation of revenue for management. This paper reviews the causes of change from free to fee hunting, the context in which it occurs, consequences of change, and implications for the future.

Cause of Change

Hunting has definite problems of supply and demand. Demand for hunting is high even though hunter numbers were down slightly from 17.4 million in 1980 to 16.7 million in 1985a. According to the United States Fish and Wildlife Service 1985 National Survey of Fishing, Hunting and Associated Recreation. Hunting generated $10.1 billion in the U.S. during 1985. Supply of hunting opportunities may be decreasing however. A 1986 survey of hunters by National Family Opinion Research Inc., provided insight about why hunters have become discouraged. The top five factors were:

1. Poor access to hunting land;
2. Crowded hunting areas;
3. Finding time to go hunting;
4. Less cooperation from landowners; and
5. Less game in general.

In the East, Brown et al. (1984) reported a steady increase of lands being posted against hunting access in New York between 1963 and 1980. By 1980, approximately 50% of the private land in upstate New York was posted. If posting continued to increase at rates experienced between 1963 and 1972, all private land in New York would be posted in 1993. In the West, Guynn and Schmidt (1984) reported that 79% of private land was closed to hunting in Colorado during 1977, up from 68% in 1969 (Rounds 1975).

Access was considered a major problem by wildlife administrators in 26 of the 50 states (Wright and Kaiser 1986). In western states with 16-75% of the area in public land, 91% of administrators indicated that access was a major problem. In contrast, states where public lands occupied $\leq$15% of the area, 57% of administrators felt that hunter access was a minor problem.

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