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Bovine Tuberculosis in Michigan: The Work on the Wildlife Side

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ABSTRACT: In 1975 and again in 1994, bovine tuberculosis (TB) was diagnosed in a free-ranging white-tailed deer taken by a hunter in the Michigan's Northeast Lower Peninsula. In subsequent testing of deer, it was clear that deer were not spillover hosts but, in fact, the infection was being sustained in the deer population. While bovine TB had been detected elsewhere in wildlife, this was the first time in North America that bovine tuberculosis was shown to be sustained in wildlife. While TB had no discernible effect on deer populations, it apparently provided a reservoir of infection to cattle. In 1998, TB was detected in cattle herds, which eventually prompted the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) Veterinary Services (VS) to reduce Michigan's TB status. The reduced status places significant burdens on producers selling cattle interstate. While VS has considerable experience and success in eradicating TB from cattle, eradicating TB from wildlife presents a very new scientific and social challenge. This paper outlines the progress of eradication efforts undertaken by Michigan Department of Natural Resources and USDA-APHIS–Wildlife Services (WS). Methods used include reducing deer numbers through hunting, regulating the feeding and baiting of deer, special permit shooting, barriers, and a 2004 pilot project that identifies and removes suspected TB-positive deer.

KEY WORDS: baiting, bovine tuberculosis, fencing, hunting, *Mycobacterium bovis*, *Odocoileus virginianus*, supplemental feeding, white-tailed deer

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INTRODUCTION

In 1975, bovine tuberculosis (TB) was diagnosed in a hunter-taken white-tailed deer (*Odocoileus virginianus*) from Alcona County, Michigan. This was considered an isolated occurrence until 1994, when bovine tuberculosis was diagnosed in another deer taken by a hunter in Alpena County, approximately 9 miles from the location of the 1975 animal (Schmitt et al. 1997). By 1997, in subsequent testing of deer by the Michigan Department of Natural Resources (MDNR), it was clear that deer were not merely spillover hosts but, in fact, the infection was self-sustaining in the deer population (Schmitt et al. 1997). While bovine TB had been previously detected elsewhere in wildlife, this was the first time in North America that bovine TB was being sustained in wildlife (Schmitt et al. 1997). While TB had no discernible effect on deer populations, the deer apparently provide a reservoir of infection for cattle. This poses a serious challenge for the $1-billion Michigan livestock industry since trade barriers and regulations are imposed by other state departments of agriculture and by USDA APHIS Veterinary Services (VS) on states with a demonstrated prevalence of TB. While bovine TB does pose a slight human health risk, it is primarily a market access issue for livestock producers. There is also concern for the free-ranging deer herd. Deer hunting is an immensely important tradition in Michigan, with more than 1.7 million deer licenses sold annually, generating approximately $1 billion.

Eradicating TB from cattle has been quite successful in the United States in the last 70 years (Hickling 2002). The proven approach involves established protocols of testing and removal, slaughterhouse surveillance, and cattle movement restrictions. This approach is being implemented in Michigan to eradicate TB from livestock. However, eradicating TB from wildlife has no such established protocols.

ISSUE

Bovine TB, caused by the bacterium *Mycobacterium bovis*, is a disease spread primarily by close contact with infected animals and exacerbated by crowding and stress (Schmitt et al. 1997). It is a chronic, debilitating disease with a long incubation period. Animals that become infected generally do not show symptoms and may live and potentially spread the disease for years.

Extensive surveillance of wildlife by MDNR, principally white-tailed deer, indicate that TB was primarily centered in 5 counties of the northeast Lower Peninsula, i.e., Alpena, Alcona, Montmorency, Oscoda, and Presque Isle (Schmitt et al. 1997). The area can be further refined to an area of approximately 600 mi^2 at the juncture of Alpena, Alcona, Montmorency, and Oscoda Counties in which 75% of all TB+ deer have been located (Figure 1). This area is referred to as the "TB core area" or Deer Management Unit (DMU) 452. Within this area, TB prevalence in deer is not uniformly distributed, but it varies widely with some townships having recorded infection rates of nearly 7%. These 12 high-prevalence townships are generally referred as "hot townships". These are "hot spots" and not an artifact of sampling (Hughey 2003).

Surveillance also identified TB in several carnivores such as raccoons (*Procyon lotor*), coyotes (*Canis latrans*), opossums (*Didelphis virginiana*), black bears (*Ursus americanus*), bobcats (*Felis rufus*), and red fox (*Vulpes vulpes*) (Michigan Bovine Tuberculosis Eradica-

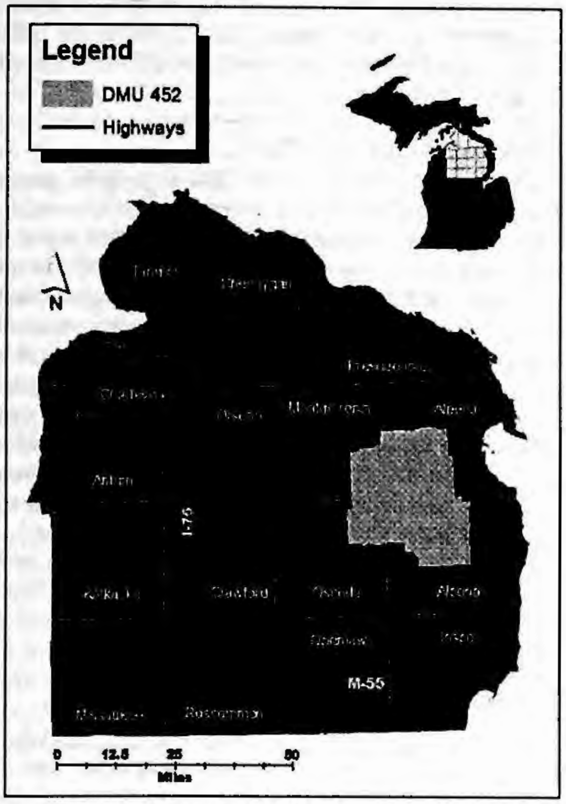

Figure 1. Bovine tuberculosis has been sustained in deer, in northeast Lower Peninsula of Michigan. The disease is almost entirely contained within Presque Isle, Montmorency, Alpena, Oscoda, and Alcona Counties, and the highest prevalence rates in deer are within Deer Management Unit (DMU) 452.

tion Project 2002). It is considered that these species contracted TB by feeding upon infected deer carcasses. Although it is thought doubtful that these species can transmit the disease (MDNR 1999), they have not been entirely eliminated as having some role in maintaining infection (Gary Witmer, USDA NWRC, Fort Collins, CO, pers. commun.).

According to Hickling (2002), TB does not appear to be expanding spatially, but as the result of intensified surveillance, it has been detected in outlying areas at very low levels, i.e., 1 deer per county. At these low levels, it does not appear to be a risk for cattle or free-ranging deer.

The consensus amongst scientists suggests that the maintenance of the infection in white-tailed deer is directly related to supplemental feeding and baiting and the increased densities of deer it creates (Hickling 2002, Schmitt et al. 1997, Brunning-Fann et al. 1999, Peyton 1997, Squibb 2000, Miller et al. 2003). Supplemental feeding consists of placing feed such as carrots, sugar beets, and corn in large quantities– tons, in some cases– to enable deer to survive the winters. This practice congregates, in an unnatural way, large numbers of deer for prolonged periods of time. Under these circumstances, the inhalation of *M. bovis* or consumption of feed containing *M. bovis* is much more likely to occur than in natural conditions (Brunning-Fann et al. 1999). Supplemental feeding was widely practiced in the Northeast Lower Peninsula, which is known as the "club country" region, referring to the many private clubs that are managed specifically for recreational deer hunting. This practice, along with factors such as a series of mild winters and the reluctance to harvest does, has maintained deer densities well above the natural carrying capacity.

In 1998, TB was detected in cattle herds in NE Michigan, which resulted in a reduction in Michigan's TB status by VS in 2000. According to Leefers et al. (1997), the estimated loss in net receipts to farmers could be as high as $67 million for the period 1999 - 2003. In response, a Statewide Bovine TB Committee was formed, consisting of representatives from the Michigan Departments of Agriculture, Community Health and Natural Resources, U.S. Department of Agriculture, and Michigan State University. A strategy emerged that focused on livestock, captive cervids, and wildlife. This paper will review the management actions undertaken by MDNR and WS to reduce the TB prevalence in wildlife and reduce the transmission of TB between livestock and wildlife.

DEER HARVEST

This strategy focuses on reducing deer number in NE Michigan to a level that is sustainable by the natural environment without supplemental feeding. Not only would a smaller deer herd result in reduced transmission, it would lower the average age of the herd. This is desirable because older deer are more likely to be infected and, therefore, more likely to transmit the disease (Brunning-Fann et al. 1999). The most efficient and publicly acceptable way to reduce the deer herd was deemed to be through hunting. MDNR increased harvest in the TB core area through the extending antlerless seasons and by increasing the availability of antlerless licenses during existing deer seasons.

According to MDNR estimates, the deer herd in the 5-county area has been reduced by approximately one-third compared to the mid-1990s (Hickling 2002). Not surprisingly, this was viewed differently among various stakeholders. To MDNR deer managers, this is considered progress in returning the deer herd to a level in balance with the habitat. To deer hunters who observed fewer deer, this was extremely unwelcome.

SUPPLEMENTAL FEEDING AND BAITING

In 1998, the first version of a ban on deer feeding and baiting was initiated. It has subsequently gone through almost yearly revisions and modifications. Currently, the regulation completely bans on feeding and baiting in the 5-county TB area. In other parts of the state, it has been allowed with certain stipulations (MDNR 2004).

In the 5-county TB area, the compliance with this regulation has not been complete, but it has been increasing. As noted in regular aerial observations by MDNR, large-scale supplemental feeding has decreased dramatically; the supplemental feeding that continues is with much smaller amounts (Michigan Bovine TB Eradication Project 2002). Baiting has decreased somewhat but is still considered to be widespread.

FENCING

Research has indicated that the route of transmission is unlikely to be through direct contact between deer and cattle (J. Hill, USDA-WS, Gaylord, MI, pers. commun.). However, it is known that *M. bovis* can survive at cold temperatures for up to 12 weeks (Palmer and Whipple 2000), making it possible for the bacteria to be transmitted indirectly on feed, e.g., infected deer feed on hay bales stored outside on a farm which are then fed to cattle. To prevent or reduce this mode of transmission, WS initiated in 2001 a pilot project to provide practical and effective fencing to exclude deer from stored feed. Generally, two fence types– woven wire and electric– were offered to farms located in any county with TB+ cattle or deer. The woven wire fences are 10-foot tall, very effective, and more expensive than other types of fence. Electric fencing is not quite as effective, but it is cheaper and has the added advantage of being movable. WS provides the materials and labor and the producer is responsible for maintenance. Originally, the fencing was planned to be offered on a cost-share basis, but the initial response from producers was so tepid that the cost-share concept was suspended.

To date, 22 farms have received fencing at an average cost of $6,500. In follow-up visits, no deer intrusions have been observed although, in a few cases, some gates have been left open.

DISEASE CONTROL PERMITS

The increased deer harvest has reduced the deer herd significantly over the 5-county area. MDNR also offered a means to reduce deer on a smaller scale, i.e., at the farm level. An additional measure to decrease the risk of transmission was made available in the form of permits to shoot deer thought to be a threat on individual farms. These permits, referred to as disease control permits or Bovine TB Control permits, are issued at no charge to the farmers and allow for the taking of a certain number of deer on designated properties. Although permits can be issued at any time, they are generally limited to times when there are no deer seasons. The farmers can act on the permit themselves or have others, such as friends or WS personnel, act on their behalf. The carcasses can be retained by the farmer, but it is requested that the heads be submitted for TB testing.

Disease control permits were first available in 1998 and were in addition to crop damage permits available to farmers to protect their crops. According to DNR records, which do not distinguish between disease control permits and crop damage permits, the number of animals taken with permits has declined substantially, i.e., in 1998, 326 deer were removed compared to 37 in 2003. MDNR states their willingness to issue permits has remained the same throughout this period (G. Matthews, MI DNR, Gaylord, MI, pers. commun.).

It is speculated that requests for disease control permits have declined for several reasons. Clearly, there are fewer deer in NE Michigan. It is reasonable to assume that numbers are down, so farmers are seeing fewer deer and concluding that the threat of transmission is much less. Secondly, in this area there is a perceived social cost, an ostracism that is attached with shooting deer out of season. This reflects the high regard that deer have here. Thirdly, the threat of TB may be viewed by some farmers as not particularly likely or costly, especially since farmers are indemnified 100% for cattle taken from TB+ farms.

THE NEW STRATEGY - 2004

By 2003, there was evidence that suggested progress to eradicate TB had reached a plateau. For example, the number of TB+ farms continued to be detected at a rate of approximately 5 per year, and the prevalence of TB+ deer in the TB core area had remained steady at approximately 2.5% for 4 years. While increased hunter harvest had reduced the deer significantly, it was recognized that there was little sentiment amongst hunters to reduce the deer herd further. Furthermore, there was no legal option to reduce deer numbers through an agency hunt, nor was there the political incentive to pursue one. It became apparent that, according to one projection (Figure 2), while the intervention strategy had prevented the prevalence from increasing, additional measures might be necessary to achieve the goal of eradication. This led MDNR, with assistance from WS, to pursue a novel pilot project in 2004.

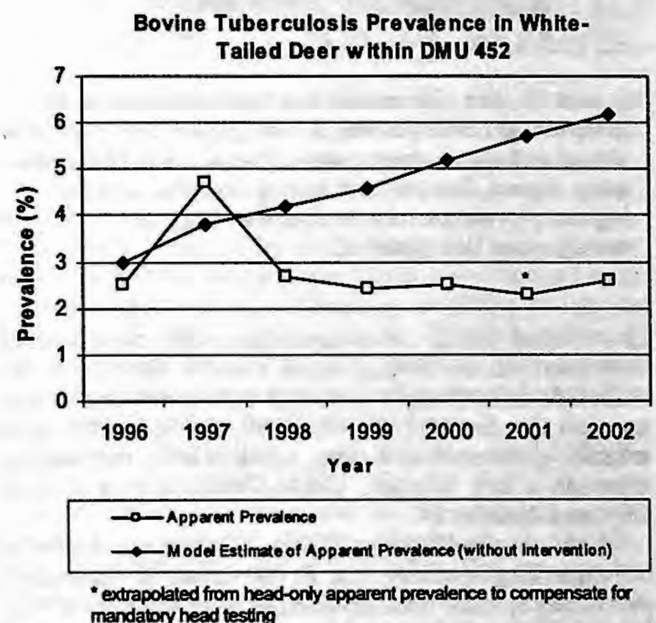

Figure 2. Comparison of apparent bovine tuberculosis prevalence in deer within Michigan Deer Management Unit (DMU) 452 to apparent prevalence estimated by a model based on conditions without intervention (McCarty and Miller 1998).

The project attempts to identify TB+ deer in the TB core area by means of live-trapping animals in Clover traps and taking blood samples. The deer are radio-collared, ear-tagged, and released. Meanwhile, the blood is tested for TB by means of a gamma-interferon test (Cervi-gam™) from which results are available in 5 days. If a deer tests positive, it is to be located by radio-telemetry and shot. All collars are designed to drop off approximately 90 days after activation, allowing for recovery and re-use.

The pilot project began in January 2004 on 2 hunt clubs in the TB core area with approximately 80 traps. As of February 29, 2004, excluding recaptures, 102 individual deer had been captured. Of these, about half were fawns, and because fawns are not likely to be infected, they were not radio-collared, but blood samples were taken for TB testing. Two deer tested positive and both were removed; one was recaptured in a trap and the other was shot. Subsequent testing, including culturing, is underway to confirm that these animals were, in fact, TB+. Trapping is scheduled to continue as long as there is sufficient snow, which could be well into March.

This pilot project poses at least four important practical questions: 1) Can sufficient numbers of deer be trapped? 2) Will the TB test be sufficiently accurate and practical for field use? 3) Will the radio-collars function properly? and 4) Can specific collared animals be located and shot once they have tested positive? These questions and other concerns will attempt to be answered in 2004. If these questions can be answered in the affirmative, this method may be put to further testing in an attempt to answer the larger question– whether it will provide an effective option to bring about a real reduction in prevalence rate in deer. If the conclusion is that this strategy appears promising in reducing TB prevalence in deer and thereby reducing the risk of transmission, it may be applied on a wider scale.

OUTLOOK

The intervention to eradicate TB in Michigan has achieved some success in reducing its prevalence in deer. However, according to Hickling (2002), modeling of the infection risk that wild deer pose to cattle suggests that deer management actions undertaken up until 2002 were unlikely to restore Michigan's accredited TB-free status. The prospects of achieving this goal would be increased with additional reductions in deer numbers and a decline in supplemental feeding and baiting, together with efforts by livestock producers in keeping deer and livestock apart. The consensus amongst scientists is that complete eradication will take at least a decade (Hickling 2002, Brunning-Fann et al. 1999, Corso 2000).

As in any wildlife damage management issue, there is a significant human dimensions component to bovine TB in Michigan. Both agriculture and wildlife stakeholders have paid a considerable cost and still have a great deal at risk. Any progress to be made in eradicating TB will require not only additional answers from scientists but also further accommodation by both the hunting and agriculture communities – as well as patience (Hickling 2002).

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