PURDUE EXTENSION

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Bovine Tuberculosis in Wild White-tailed Deer

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What Is Bovine Tuberculosis?

Description

Bovine tuberculosis (bTB) is a bacterial disease of mammals resulting from the infection of *Mycobacterium bovis (M. bovis)*. Bovine tuberculosis is a **zoonotic** disease, meaning it can move between animals and humans. Tuberculosis infections in humans, domestic stock, and wild animals can result from *M. bovis*. Bovine tuberculosis cases account for less than 2% of all tuberculosis cases in humans[3], but outbreaks of bTB have occurred sporadically around the world in domestic and wild animals since the 1900s.

Transmission

Most often, bTB is transmitted when respiratory or other secretions are transferred between animals, although alternative sources of infection do exist[4]. Transmission happens when uninfected animals directly contact infected animals or when uninfected animals contact contaminated materials such as animal feed and mineral licks[7]. Transmission happens more often when animals occur in high densities or

Hunters: Key Considerations

If you hunt where bTB has been found in the past, take these steps when processing wild white-tailed deer:

- Be sure to look for lesions in the internal body cavity of any deer you harvest.
- If lesions are present, contact an Indiana DNR biologist or conservation officer.
- Always follow proper safety techniques when processing deer:
  - Wear gloves.
  - Use clean knives for each step of the process (field dressing, skinning, butchering).
  - Thoroughly wash your hands after field dressing, skinning, and butchering deer.
- Cook venison to an internal temperature of 165 degrees Fahrenheit to kill any bacteria.
- Check the Indiana DNR Bovine TB website for updated information on the status of bTB.

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are concentrated in areas such as cattle feeding lots or at wildlife bait, mineral, or supplemental feeding sites[10].

Although direct contact between wild white-tailed deer *(Odocoileus virginianus)* and cattle *(Bos taurus)* is rare, indirect contact at cattle feeding sites or stored feed (e.g., open end of Ag-bag) is common[9]. This suggests the primary pathway of transmission for bTB between deer and cattle is through indirect contact at contaminated feeding sites, rather than through direct contact. However, direct contact among wild deer is frequent, and direct contact between captive and wild cervids does occur, albeit less frequently[9,24]. Small to medium-sized carnivores such as badgers *(Taxidea taxus)*, coyotes *(Canis latrans)*, opossums *(Didelphis virginiana)*, and raccoons *(Procyon lotor)* can also be exposed to *M. bovis* by scavenging on the carcasses of infected animals or by consuming contaminated feed.

Transmission of *M. bovis* to humans typically occurs when people eat unpasteurized dairy products, but people can also contract *M. bovis* directly through an open wound[3].

Hosts

Carriers of *M. bovis* range widely and can be split into three categories: spillover hosts, maintenance hosts, and reservoirs.

- **Spillover hosts** require continued exposure to infected individuals of another species to maintain the infection.
- **Maintenance hosts** can maintain the infection without cross-transmission to other species.
- **Reservoirs** are capable of transmitting bTB to other species through repeated contact[13].

Maintenance hosts can become reservoirs as the prevalence rates of bTB increase within that host species. Cattle are the primary domestic reservoir of bTB, but captive cervids [e.g., elk *(Cervis canadensis)* and white-tailed deer] also serve as reservoirs for *M. bovis*. Wildlife such as opossums and raccoons are considered spillover hosts, whereas white-tailed deer are the only known wild reservoir of *M. bovis* in the United States[15].

Bovine Tuberculosis in Indiana

Current Status

Bovine tuberculosis has been rare in the state of Indiana. Indiana's first incidence of bTB in cattle in 40 years occurred in November 2008 in Franklin County when a single cow tested positive. A captive elk and deer herd in Franklin County tested positive for *M. bovis* in 2009 and was subsequently depopulated. Indiana's first infected cattle herd was found in 2011 in northern Dearborn County. A second and third bTB positive cattle herd were identified in 2016 in Franklin County. The first known bTB-positive wild white-tailed deer was taken from the affected cattle farm near Metamora in August of 2016. To date, confirmed cases of bTB in Indiana have been from the same strain of *M. bovis* typically called the "cervid" or "elk" strain. This particular strain has been traced back to captive cervids in Kansas from the late 1990s.

The occurrence of bTB in wild white-tailed deer led the Indiana Department of Natural Resources (DNR) and Indiana State Board of Animal Health (BOAH) to take immediate action to limit the spread of the disease among wild deer and cattle. The DNR initiated the 2016 bTB Management and Surveillance Zones in Fayette, Franklin, and Dearborn County to monitor and manage the spread of bTB in wild white-tailed deer. Hunters submitted over 2,000 deer during the 2016 deer season with no hunter-harvested deer testing positive for bTB. This allowed the DNR to estimate the environmental prevalence rate of bTB in a 10-mile zone around the Dearborn site and or in Franklin and southern Fayette County. The DNR concluded that bTB is not common, with prevalence rates lower than 0.25% within a 10-mile radius of the infected cattle farms in Franklin County, and likely 0% within a 10-mile radius of the 2011 farm bTB-affected in Dearborn County. It is also likely the single positive deer found on the bTB affected farm in Franklin County was a spill-over event and not necessarily an indicator that bTB is present in the area's deer population.

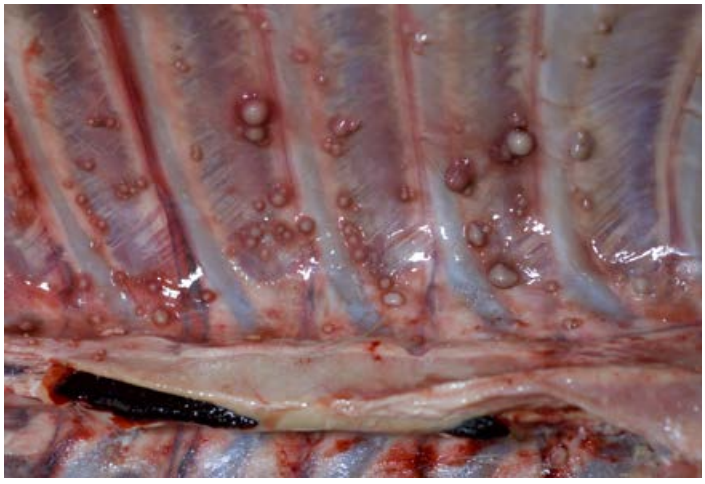
2016 bTB Management and Surveillance Zones

Bovine Tb Management and Surveillance Zones in Indiana as of December 2016.

Indiana DNR employee Sandy Clark-Kolaks extracts lymph nodes from a hunter-harvested deer to determine bovine tuberculosis prevalence rate during the 2016 hunting season. *Photo courtesy of the Indiana Department of Natural Resources.*

Clinical Signs

The clinical signs of bTB infection can vary with the route of infection and the response of each individual. Clinical signs of bTB infection are somewhat similar in domestic cattle and white-tailed deer based on how the animal contracts the infection. Lungs and internal body cavities of infected animals typically have lesions that range from small yellowish nodules to large tan formations. The lesions inhibit most lung function, but may be difficult to observe in infected deer and are not always present. In a study of captive deer, 9 of 14 (64%) bTB-positive deer displayed these tuberculosis lesions[20].



Lesions from bovine tuberculosis infection on the lungs (top) and ribcage (bottom) of a wild white-tailed deer. *Photos courtesy of the Michigan Department of Natural Resources.*

The lymph nodes of infected animals swell with infectious nodules. Lesions in lymph nodes and lungs appear as early as 28 and 42 days after infection, respectively, but some individuals may live for years without visible lesions[16]. In all infected species, bTB can remain as a chronic, dormant disease for long periods of time in which infected animals show no external signs of infection, but shed the bacteria in the environment[23]. To test for bTB infection, lymph nodes in the head (medial retropharyngeal, submandibular, and parotid) are collected from harvested deer.

Lymph nodes extracted from a hunter-harvested deer to test for bovine tuberculosis in southern Indiana, 2016. *Photo courtesy of the Indiana Department of Natural Resources.*

Bovine Tuberculosis and Wild White-Tailed Deer

Bovine tuberculosis has been detected in wild white-tailed deer in Ontario, New York, Michigan, Minnesota, and Indiana and is considered endemic in Michigan[10]. This is the first occurrence of the cervid strain of bTB found in Indiana's white-tailed deer and the first occurrence outside of captive animals. Bovine tuberculosis eradication efforts have been conducted in both Michigan and Minnesota. Both states use similar disease management principles: reducing wild deer herd density and restricting baiting and supplemental feeding of wildlife to limit the amount of contact between uninfected and infected deer at congregated sites.

Bovine tuberculosis and deer meat

Most cases of bTB in humans are caused by consuming unpasteurized dairy products rather than eating or handling meat products. There has been only one confirmed case of bTB transmission to a human from an infected white-tailed deer. In that case, bTB transfer was thought to have happened when blood from the infected deer contacted an open wound on the person during the field dressing process[26].

Again, it is important to mention that the likelihood of contracting bTB from wild deer is very rare. Bovine tuberculosis is uncommon in the muscle tissue (meat) of harvested deer, but may be present in internal body cavity fluids and can be transferred to the meat through poor meat-handling techniques. However, there are steps you can take to further minimize the risk of bTB contact.

- Always wear gloves when field dressing, skinning, and processing a deer.
- Thoroughly clean knives used for field dressing prior to using them to skin or further process a deer—or use different knives for each step of the butchering process.
- Cook the meat from harvested deer to an internal temperature of 165 degrees F to effectively kill *M. bovis* and other bacteria.

Effects on deer populations

Currently, bTB is believed to have little effect on individual deer or their populations. Because the disease is generally rare in wild populations, any potential effect on the population caused by chronic illness of infected individuals is diluted. This means that bTB is unlikely to limit population growth by increasing death rates or decreasing reproductive rates. There is no evidence that bTB affects body size, antler growth, or other characteristics of individual deer. However, bTB is not a naturally occurring disease in wild populations, and there is still much to learn about the long-term impacts.

Bovine Tuberculosis Management — Lessons Learned

Quick action and continued monitoring

The first hunter-harvested white-tailed deer with bTB in Michigan was found in 1975 and the second in 1994. There was no bTB surveillance or management action taken in Michigan between 1975 and 1994. Bovine tuberculosis occurred at a 5% prevalence rate in white-tailed deer in the 16 km^2 management zone when surveillance was initiated in 1995. At the onset of management, deer were likely already a reservoir of bTB; the disease was likely endemic to the north part of the Lower Peninsula in Michigan[11,15]. As of 2011, bTB occurrence in Michigan had stabilized at <2%, but still persisted in wild white-tailed deer in the state[14].

Bovine tuberculosis was found in a beef cow at a slaughterhouse in Minnesota in July of 2005[1]. Sampling deer during the 2005 hunting season yielded the first wild white-tailed deer bTB case in Minnesota. Landowners in close proximity to bTB-positive cattle farms received additional harvest permits in January of 2006, which resulted in detection of a second positive deer. Intensive bTB monitoring began in early 2006 and aggressive management began in November of 2006. In 2007, the prevalence rate of bTB was 1.23% in white-tailed deer collected by sharpshooters and was 0.43% in samples collected by hunters in Minnesota[1]. After the initial aggressive action and continued monitoring of wild white-tailed deer, no bTB-positive deer have been found in Minnesota since 2009[12]. Currently, bTB is listed as "below detection level" in Minnesota and deer are considered a maintenance host, but not a reservoir, in the state[11].

Herd reductions to reduce transmission

The spread of bTB is also density dependent meaning that transmission between infected sources and uninfected animals occurs at higher rates with increased sources of contamination or infected animals[25]. Therefore, the management and eradication of bTB depends on reducing the number of infected animals and reducing contact between individual deer. When bTB occurs in captive cervids or cattle operations, the entire herd is depopulated. It is implausible to eliminate an entire wild deer herd in an area where bTB is detected. Reducing the density of deer in a management zone has proven to be the most effective management option for reducing the transmission of bTB.

Herd reductions were integral to the management of bTB in Minnesota and continue to be an important step in Michigan[1,14,22]. Herd reductions were undertaken through increasingly liberalized harvests, extensions to hunting seasons, out-of-season reduction tags for landowners in bTB management zones, and ground and aerial shooting by trained professionals. However, if hunters oppose deer reductions to eradicate bTB or become less willing to hunt as deer density decreases, state agencies may not be able to reach the target reduction levels necessary to eradicate bTB in wild deer[5,22].

Restrictions on baiting and supplemental feeding

Laboratory studies confirmed the transmission of bTB from infected deer to uninfected deer and from infected deer to uninfected cattle through shared feeding[17,18]. Other studies reported *M. bovis* survived at least 123 days on items commonly fed to white-tailed deer at temperatures typical of winter months in Michigan, and *M. bovis* can survive on salt or mineral blocks for more than 3 days[7,19]. Furthermore, baiting and supplemental feeding artificially congregates deer and increases contact between deer, exposing uninfected deer to infected deer or feed[6]. Supplemental feeding of wildlife has been identified as one of the four greatest risk factors for the establishment of bTB in wildlife populations in the United States. Any attempts to eradicate bTB from white-tailed deer populations without banning baiting or supplemental feeding are likely to fail[11,21,22].

Cattle Producers: Key Considerations

If you own cattle in an area where bTB has been found in the past, consider the following to limit deer and cattle interactions:

- Fence areas where cattle feed is stored.
- Only feed cattle an amount that can be consumed in a day.
- Store feed near buildings away from deer.
- Close the end of large plastic bags used to store corn, haylage, or silage and also remove any feed from the ground around the ends of the bag.
- Use hunting as a management tool around your farm.

Restrictions on baiting and supplemental feeding were used to limit transmission of bTB in wild deer in Michigan and Minnesota. However, the strategies had mixed results in each state. Initially, restrictions on baiting and supplemental feeding were voluntary in Michigan rather than mandatory[15]. In Michigan, which has a long tradition of baiting and supplemental feeding, the majority of resident hunters opposed a ban on baiting (57%) and supplemental feeding (55%) to reduce the transmission of bTB[5]. Additionally, when the Michigan DNR restricted baiting and supplemental feeding, the restrictions were met with public opposition. Supplemental feeding and baiting continued illegally within the bTB management zone[15].

Alternatively, baiting was illegal in Minnesota prior to the outbreak of bTB, but supplemental feeding was legal at the onset of the outbreak. Minnesota banned supplemental feeding within the bTB management zone immediately following the first case of bTB in wild deer. Minnesota's ban on supplemental feeding was not as contentious as Michigan's and the ban was met with high compliance rates[2].

Hunter, landowner, and public support — essential to meet management goals

One of the most striking differences in the management efforts for bTB in Michigan and Minnesota was the differences in public and private land within the bTB management areas in each state. The bTB management zone in Michigan was 90% private and 10% public, compared to 60% public and 40% private in Minnesota. This difference in the proportions of public and private land resulted in differing involvement, cooperation, and support from the public in the management of bTB. Although the states had similar goals to limit the spread of bTB by (1) reducing deer densities and (2) banning baiting and/or supplemental feeding in the bTB management areas, the states differed in their abilities to accomplish those objectives.

Most hunters and cattle farmers supported the eradication of bTB in Michigan; however, most hunters also opposed herd reductions and banning baiting and supplemental feeding to eradicate bTB, which ultimately hindered the initial management of bTB in the state's wild deer herd[5,15]. In Minnesota, the DNR was able to aggressively reduce deer densities on public land and also to garner greater support for deer herd reductions and a ban on supplemental feeding from landowners, cattle producers, hunters, and the general public[2]. It is clear that public awareness, acceptance, and tolerance of strategies to control bTB in wild deer is integral to managing bTB.

Limit deer and cattle interactions

Limiting the interaction between deer and cattle is effective for reducing the spread of bTB from deer to cattle when done with herd reductions and feeding bans[22]. Bovine tuberculosis is spread through shared feeding; therefore, it is important to keep wild deer out of areas where cattle are fed or where feed is stored. This can be done by following a few general guidelines[9]. Common best management practices for reducing cattle-to-deer interaction include:

- Fence areas where cattle feed is stored.
- Only feed cattle an amount that can be consumed in a day.
- Store feed near buildings away from deer.
- Close the end of large plastic bags used to store corn, haylage, or silage and also remove any feed from the ground around the ends of the bag.
- Use hunting as a management tool to reduce deer density around your farm.

Summary

Bovine tuberculosis is a disease that has negative implications for human health, the livestock industry, and wildlife; therefore, management of bTB is not only important for livestock producers, but also for hunters and the public. The steps necessary to eradicate bTB from wild deer may include temporary deer herd reductions, banning supplemental feeding, limiting the interaction of cattle and wildlife, and continued monitoring and surveillance.

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