Michigan

Bovine Tuberculosis

Eradication Project

Activities Report 2008

Michigan Department of Agriculture
Michigan Department of Community Health
Michigan Department of Natural Resources
Michigan State University
United States Department of Agriculture

Michigan's Bovine Tuberculosis Eradication Project

INTRODUCTION

Bovine Tuberculosis (TB) is an infectious disease that is close to being eradicated in the United States, but still poses a significant risk to domestic livestock, wildlife, companion animals, and humans throughout the world. The Michigan Bovine TB Eradication Project involves a multi-agency team of experts from the Michigan Departments of Agriculture, Natural Resources and Community Health, Michigan State University, and the US Department of Agriculture.

Matt Ankney
Coordinator, Bovine TB Eradication Project
Michigan Department of Community Health
5th Floor Capitol View Building
Lansing, MI 48913

email: ankneym1@michigan.gov
Office: 517-335-9970
Cell: 517-930-3206

Contents

International and Regional Cattle Updates

Michigan Cattle Updates

International and Regional Wildlife Updates

Michigan Wildlife Updates

Contents

Michigan Community Health Updates

Research and Extension Updates

Success in controlling bovine Tuberculosis in domestic species in the face of wild animal reservoirs

Paul Livingstone
New Zealand Animal Health Board

Introduction to New Zealand
New Zealand is a country of two islands with approximately 27 million hectares (66 million acres). There are four million people; 68 percent are European, 16 percent Maori, and eight percent each Asian and Polynesian. Both cattle and deer are commercially raised in NZ. There are 9.6 million head of cattle in 72,200 herds, with 5.8 million of these dairy cows in 14,500 herds. There are 1.8 million farmed deer in 3,500 herds. These livestock operations contribute more than 30 percent of New Zealand's export earnings.

Historical background to TB in New Zealand 1905 - 1993
In 1905, a voluntary bovine TB scheme was introduced. It failed. In 1945, voluntary TB testing of dairy cattle was started and testing became compulsory in 1961. Bovine TB infection in wildlife was found in 1954 (feral red deer), again in 1962 (feral pigs), and in 1967 in the brush-tail possum (*Trichosurus vulpecula*). In 1970 all dairy and beef cattle were placed under compulsory testing. It was felt at the time that bovine TB was a simple disease to control by identifying infected herds and (1) use of test and slaughter routine and (2) preventing contact of infected herds with non-infected herds.

In 1972, the Australian brush-tail possum was recognized as a source of infection (TB vector) for cattle and control of infected possum populations began. The brush-tail possum was imported into New Zealand from Australia as the basis of a fur industry in the mid-1800s, and notably, it is a different species than the North American possum. Possum control was extremely effective in decreasing bovine TB in cattle. For example, in 1970, over 95 percent of cattle herds in Buller South were infected with bovine TB. Aerial and ground possum control resulted in a dramatic decrease in infected cattle herds in a decade, with approximately four percent of herds infected in 1980.

In 1978, bovine TB was found in a farmed deer herd, resulting in voluntary TB testing of farmed deer. In the same year, the government stopped funding possum control. It became evident that without possum control, bovine TB in cattle and deer herds would increase. In 1984, the government again began funding possum control.

The three legged stool illustrates the three components that are essential for eradication of TB
There are three major components in the eradication of bovine TB – each represents a leg of a stool. Testing and removal of infected cattle and deer is critical in the eradication effort. Control of movement from infected herds is also critical, so that the infection is not spread to non-infected herds by cattle movement. And a major component is control of infected vector populations. The importance of vector control is clearly evident by examining the drastic increase in bovine TB-infected cattle herds when the government of NZ stopped funding possum control.

In 1987, the NZ government indicated that beneficiaries (*producers* – ed.) were going to have to pay for TB control. As a consequence, the National Animal Health Advisory Committee started the "User Pays – User Says" initiative. In 1993, the Biosecurity Act was introduced which requires a Pest Management Strategy (PMS) for any national or regional pest (plant, animal or micro-organism) proposed for control or eradication. Requirements include: (1) description of the proposal and its costs, (2) time-bound measurable objectives, and (3) consultation and agreement from funding stakeholders. The proposal is submitted to the Minister of Agriculture and the strategy is approved through an order in council. The strategy funding is reviewed every five years.

In NZ, the PMS for bovine tuberculosis control is administered by the Animal Health Board (AHB). The Animal Health Board is an Incorporated Society, with members made-up of those directly affected and is responsible and accountable for implementation of the National Pest Management Strategy for Bovine TB. The sole mission of the Animal Health Board is the eradication of Bovine TB to safeguard the export of dairy, beef, and venison products.

Funding for the eradication effort comes from government as well as beef, dairy, and deer farmers. Livestock disease control is funded entirely by producers, and provides funds for disease administration and databases, TB testing, and compensation (65 percent fair market value for cattle and carcass proceeds only for deer). The Crown funds 50 percent of vector control, while regional governments fund 10 percent and the farmers fund 40 percent.

The current strategy period is from 2001 to June 2013. The prime objective of the National Pest Management Strategy is to have no more than two infected herds per 1,000 herds (infected herd period prevalence of 0.2 percent) by June 30, 2013.

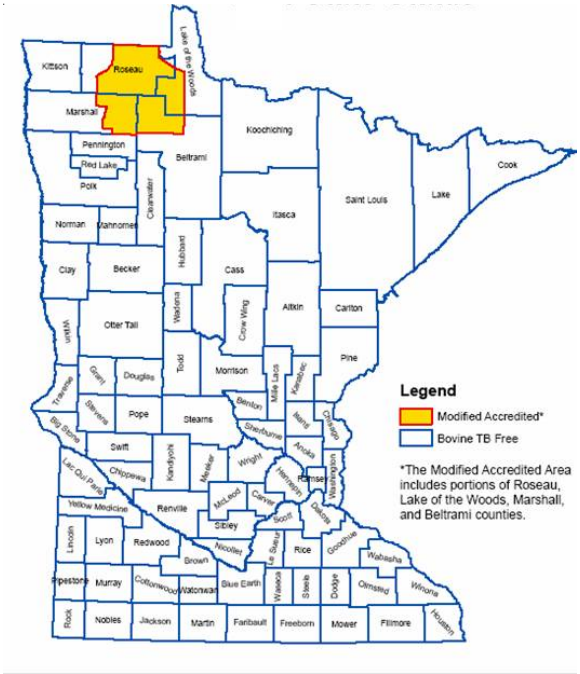
This strategy has been successful in reducing the number of infected cattle and deer herds from 511 at June 2001 to 142 at June 2008 and the annual infected herd period prevalence rate decreased from 1.32 percent to 0.34 percent over the same period. The expenditure on AHB's TB control program for 2007/08 was NZ $82M, of which $18M was spent on disease control and $55M was spent on vector control.

Bovine Tuberculosis in Minnesota cattle

William L. Hartmann
Minnesota Board of Animal Health

In 2005, a cow infected with bovine TB was identified during slaughter surveillance in a Wisconsin slaughter plant and traced to a herd in northwestern Minnesota. The Minnesota Board of Animal Health quarantined and tested the herd, and initiated an investigation. A total of 11 bovine TB-infected beef herds have been identified in the state. Minnesota lost its TB Free status in January, 2006. The state's status was lowered again to Modified Accredited (MA) in April, 2008, after four additional infected herds were found in a two-year period.

There are many similarities between bovine TB in Michigan and Minnesota. Both states have identified bovine TB in a circumscribed northern agricultural area. Also, both states have bovine TB in both domestic cattle and free-ranging deer. **There are, however, some significant differences.** The prevalence of bovine TB in deer in Minnesota is less than one-half percent, significantly lower than the prevalence in Michigan. This suggests that in Minnesota, as compared to Michigan, bovine TB is not well established in the wild white-tailed deer population. In addition, there are about 300 cattle herds in the Minnesota Modified Accredited (MA) Zone, compared to approximately 1,000 in Michigan. Finally, Minnesota has been able to implement a herd buyout program and a program to install deer-exclusion fencing in the disease Management Zone.



The goal of the Minnesota's TB Eradication program is to reduce deer–cattle interactions and eradicate (not contain or control) bovine TB from both domestic and wild animals. The state has applied for Split State Status, which hopefully will be granted by fall 2008*, and the plan is to focus resources in the MA Zone.

Ongoing issues include commuter herds, obtaining recognition of Split State Status by neighboring states, and addressing wildlife infection.

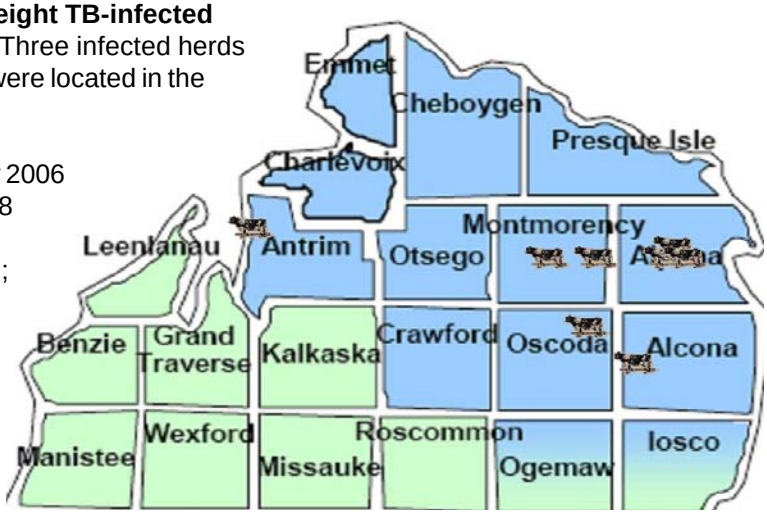
Minnesota TB Hotline: 1-877-MN TB FREE (668-2373)
Website: www.mntbfree.com

** Editor's note – USDA approved Minnesota's Split State Status effective October 10, 2008.*

Affected herds in Michigan

James Earl
United States Department of Agriculture APHIS VS

From February 2006 until January 2008, eight TB-infected cattle herds were identified in Michigan. Three infected herds were dairy and five were beef. Seven herds were located in the core five county area.



TB-infected herds were identified in February 2006 (Beef, 115 head, Alpena); April 2006 (Beef, 48 head, Alpena*); May 2006 (Dairy, 25 head, Antrim); May 2006 (Dairy, 150 head, Alpena); January 2007 (Dairy, 120 head, Montmorency); October 2007 (Beef, 169 head, Alcona*); November 2007 (Beef, 95 head, Montmorency); and January 2008 (Beef, 70 head, Oscoda). **Interestingly, two of these premises (indicated by *) were twice infected, bringing the total of twice infected premises to five.**

All herds were depopulated. Cost to depopulate these eight herds averaged $117,518 per herd (high = $324,605 and low = $29,838) for a total of $970,587. Cost to depopulate the two twice-infected premises averaged $183,635 for the second depopulation.

Michigan Department of Agriculture program update

John Tilden
Michigan Department of Agriculture

Our experience suggests that there is a continued spread of disease between wildlife and livestock. Serious challenges result from the differing views held by members of the agricultural, retail, hunting, residential, and tourist communities. The current program is expensive, with $100 million spent on the program over the past 10 years. Funding at this level cannot be maintained.

There is now an increasing demand for accountability by all groups involved. Government must provide an open and efficient program. Livestock producers must take reasonable precautions to prevent the spread of bovine TB between wildlife and cattle. Sportsmen must manage the deer herd for the health of the herd and the good of all Michigan citizens. **The challenge we face is to strike a balance between collective and personal responsibility of all involved.**

2008 initiatives include targeted surveillance to better utilize resources and quickly identify infected animals. The livestock industry must step up to the plate and provide leadership for Michigan's beef and dairy producers. Local partnerships between producers and the wildlife community can help accomplish our goal of eradicating bovine TB.

Research is critical to our eradication effort, including wildlife vaccination strategies, understanding the human dimensions of bovine TB eradication programs, computer models to assess risks and forecast impacts of program interventions, and improving cost-effective surveillance methods.

The Wildlife Risk*A*Syst Project is one way to utilize existing economic and technical programs to implement cost-effective risk mitigation techniques. Producers identified economic and technical assistance as barriers to implementing risk reduction practices. The plan is to use proven risk reduction models with the USDA

Environmental Quality Incentives Program (EQIP) and the Michigan Agriculture Environmental Assurance Program (MAEAP). The program will focus on areas of highest risk, the geographic area in and around Michigan's Deer Management Unit (DMU) 452. On-farm risk assessments will consider the likelihood of exposure to bovine TB-infected wild white-tailed deer on the farm and identifying risk reduction practices that can be implemented to protect livestock from bovine TB.

The likelihood of finding a bovine TB-infected deer is clearly linked with geographic location with the highest apparent prevalences found in northeastern Michigan's DMU 452 and dramatically decreases as you move away from that area. Clearly, resources can best be spent in areas of increased risk. Eighty-nine percent of the TB-infected cattle herds identified since 1998 have been located in the five county area that contains and surrounds DMU 452. There have been five premises that have been repeatedly infected. **Increasing separation between wild deer and livestock is the key to Michigan's eradication strategy.**

Bovine Tuberculosis in Michigan - where we are today

Michael VanderKlok
Michigan Department of Agriculture

Surveillance: Michigan has had an aggressive surveillance system for bovine TB. Between 2000 and 2003, every dairy, beef, bison, and goat herd in the state was tested. This testing resulted in no evidence of bovine TB in the Upper Peninsula (now the TB Free Zone) or the southern Lower Peninsula (now the Modified Accredited Advanced Zone). Since 1996, progressive expansion of TB testing has occurred in NE Michigan and annual testing has been done in the Modified Accredited Zone (MAZ). Over 1.4 million TB tests have been completed. Annually, 150,000 TB tests are conducted on over 3,000 herds at a cost of $5.2 million.

Movement: Specific TB testing and movement certificate requirements are in place for animals moving off the farm in the MAZ and moving between zones. Movement of cattle is continuosly tracked. In the six months from October, 2007 to March, 2008, over 3,000 movement permits involving 21,000 cattle were issued. RFID and movement certificates enable the MDA to easily identify and track cattle movement.

Targeted Surveillance: Because bovine TB has not been identified in the MAAZ and because the cost of random surveillance is high for little return on investment, MDA has decided to focus resources on areas of greatest risk of bovine TB. Surveillance will now focus on movement of cattle from TB-infected herds and herds in close proximity to TB-infected deer. Herds in proximity to infected deer can be either a geographic region or a new infection, for example, the single infected deer found in Shiawassee county.

Enforcement/Monitoring: Regulatory personnel are located at sale yards and there is a 24-hour check-point at the Mackinac Bridge. In addition, annual reconciliation of herd inventories in the MAZ and verification audits on cattle moved to slaughter enable MDA to track movement of all cattle from the MAZ.

What are the MAZ producers thinking?

Jeff Kala
MAZ Producer

Beef and dairy producers in the Modified Accredited Zone (MAZ) of Michigan have been dealing with the ramifications of bovine TB for the past decade. The eradication effort requires management changes and risk mitigation, in addition to repeated TB testing. **Despite some successes, producers in the MAZ question some of the current regulations.** For example, should test and remove be an option for TB-infected farms? This option could be important for purebred herds, cattle with high genetic value, and herds that have been managed with stringent health standards.

Targeted surveillance is another topic of debate among MAZ producers. While many feel that targeted surveillance is the right approach, others think that it could be damaging to the purebred market. Wildlife risk mitigation is another "hot topic." Although reducing wildlife-livestock contact is a rational goal, the cost of some programs appears out of proportion to the risk, suggesting that not all recommended mitigation techniques are cost-effective.

On the wildlife side of the issue of bovine TB, the consensus regarding the bait and feed ban is "Enforce it or get rid of it." MAZ producers are looking for solutions to this complex problem. Under current management, it is unlikely that bovine TB will reach undetectable levels in the deer population within the next decade (Hickling, G as cited in Schmitt et al; 2004). Further reduction in overall deer densities does not appear to be a socially acceptable option in Michigan (de Lisle et al, as cited in Schmitt et al; 2004). With the persistence of bovine TB in wild white-tailed deer, MAZ producers find the stated goal of eradication of TB in cattle, while it persists in deer, difficult to comprehend.

MAZ producer suggestions for the TB eradication program:

- Producer-driven options for bovine TB-positive animals
- Incentives for producers to reduce bovine TB risk on their farms
- Enforce the baiting/feeding ban in northern Michigan
- Utilize feasible wildlife management suggestions (encompass multiple stakeholders)
- Incentives for hunters to decrease deer population
- Guide good sense with science

Shiawassee County TB testing - Incident Command System

Daniel E. Harpster
United States Department of Agriculture APHIS VS

On February 20, 2008, a deer from Shiawassee County was confirmed infected with bovine TB. The immediate vicinity was designated as a "potential high risk area" which requires testing of all cattle herds in a 10-mile circle. This testing was started on March 4, 2008. As of July 15, 2008, 158 of the 168 identified cattle herds have been tested and there is no evidence of bovine TB in cattle in this 10-mile circle.*

The Incident Command System (ICS) was used to organize the TB testing in the 10-mile Shiawassee circle. This system, developed from the system used by fire fighters in areas of wildfire, provides an organized approach to address/manage an event/incident. Forest Services "Para-Military" Structure has been successfully used in a variety of situations since the 1970s. The ICS provides a structured, yet flexible way to manage an ongoing situation, with emphasis on communication. It also provides a better structure to track expenses.

A key to success and a major component of the ICS is communication and cooperation. This was a successful multi-agency effort. The ICS team consisted of individuals from Michigan Department of Agriculture, USDA APHIS Veterinary Services, Michigan Department of Community Health, and the Michigan State Police. Public meetings were held and cooperation between producer groups, MSU Extension, College of Veterinary Medicine, wildlife enthusiasts, Shiawassee and Clinton Counties' Emergency Management Agencies, Shiawassee County Health Department, and Shiawassee County Fairgrounds were involved in the successful completion of TB testing in the Shiawassee 10-mile circle.

** Editor's note – the high risk designation was officially dropped on December 1, 2008, after whole herd testing revealed no infected cattle herds in Shiawassee County. Two areas in Iosco County also had their designations removed after completing similar circle testing of cattle herds.*

Bovine TB Communications

Bridget Kavanagh-Patrick
Michigan Department of Agriculture

Priorities have been identified to start public outreach regarding the needed changes and future requirements for wildlife risk mitigation plans in the MAZ. State agencies are working with MSU Extension, Farm Bureau, and other partner agencies to educate producers on the risks associated with farming in the bovine TB zone of northern lower Michigan.

On January 24, 2008, MDA issued a news release regarding the Iosco County bovine TB positive deer and the establishment of two Potential High-Risk Areas. The press release also included information regarding the (then)

suspect deer in Shiawassee County. MDA provided stakeholders with talking points and notified legislators, local government officials, agriculture, local public health, wildlife interest groups, Michigan State University Extension, MDA, MDCH, and DNR staff prior to issuing the release.

MDA posted Questions and Answers regarding "Potential High-Risk Areas" on the emerging diseases Web site and mailed letters to impacted producers in Iosco and Shiawassee counties. The letters explained bovine TB testing requirements and the ten-mile radius "Potential High-Risk" designations in their counties. An informational meeting on bovine TB was held in Shiawassee County on Wednesday, February 13. Officials from MDA, MDCH, DNR, and USDA attend these meetings, as well as industry organization leaders.

Iosco and Ogemaw County Farm Bureaus sponsored a public meeting in Prescott on February 27, including representatives from MDA, DNR, Michigan Farm Bureau, Michigan Milk Producers Association (MMPA), Michigan Cattleman's Association, and USDA VS. Speakers answered citizen questions about testing requirements, wildlife risk mitigation, and wildlife management practices. A recurring theme was that the agricultural and wildlife communities will need to work closely together if we are going to eradicate bovine TB.

A delegation from CDC's National Center for Zoonotic, Vectorborne, and Enteric Diseases met with Michigan leaders to explore human and animal health partnerships. The CDC is interested in Michigan because of our track record of multi-disciplinary problem solving. Michigan's Bovine TB Eradication Project was mentioned as an example of bringing together state agencies, universities, and the private sector to tackle a tough issue. Communication Action Plans with associated materials are available for the Shiawassee County circle testing, wildlife risk mitigation plans in the MAZ, Risk Based Surveillance Plans, and for reaching out to the petroleum and convenience store industries regarding the sale of bait.

On April 11, 2008, industry leaders from Michigan United Conservation Clubs, Farm Bureau, the Cattlemens' Association, the Milk Producers, and MDA and DNR directors met to go over requirements for disease eradication efforts. On April 17, MDA hosted a cattle producer update in Bennington Township Hall and provided circle testing data information to approximately 50 farmers in Shiawassee County. On April 23, several meetings were held in Hillman in the MAZ. Industry leaders and the department directors visited a hunt club, toured the MAZ, and sat down with cattlemen and hunters to discuss avenues for change.

Producers in the border counties south of the MAZ received notification of the change to risk-based surveillance testing. It has been determined that counties within close proximity to the MAZ generally receive more cattle from the MAZ than counties further away, making it more practical and cost effective to look for the disease where there is a higher chance of finding it. MDA and MDCH staff attended the Michigan Food and Petroleum annual trade show to distribute baiting-ban posters and discuss the difficulties of disease eradication when store owners sell bait.

The Michigan Cattlemen's Summer Round-up was held in Alpena on June 20 and 21, 2008. MDA, Michigan State Police, and USDA Wildlife Services were featured on the program. MDA bovine TB eradication staff met with the Michigan Farm Bureau's dairy advisory committee on June 25, 2008 to provide an update and to obtain input on future directions for the program.

On July 7, 2008, local MAZ hunt clubs and producers met to discuss ways to make the bovine TB eradication program more effective.

During the summer months, road signs between the MAZ and MAAZ communicating movement certificate, testing, and animal identification requirements to persons moving cattle between zones were posted by the Michigan Department of Transportation. The signs are posted at the following locations:

- U.S 31 between Elk Rapids and Acme on the Antrim County border
- U.S. 131 between Mancelona and Kalkaska on the Antrim County border
- M 72 between Grayling and Kalkaska, entering Crawford County
- M 18 near Roscommon, entering Crawford County
- M 33 between Rose City and Alger in Ogemaw County
- M 65 near Hale (the southernmost boundary of the Huron National Forest)
- U.A 23 in Iosco County near Au Sable (the southernmost boundary of the Huron National Forest)
- I75 before and after crossing the Mackinac Bridge

A billboard with cattle movement requirements was posted where US 27 and I75 merge, as travelers enter the MAZ, for three months during peak cattle movement this fall.

A public service announcement (PSA) video asking producers to protect their feed and hunters not to bait deer was taped in July and ran during the hunting season. Another PSA on Country of Origin Labeling (COOL) and radio frequency identification (RFID) tags for cattle was produced for distribution on You-Tube and the Web in 2009.

Towards a spatially explicit model of bovine TB in white-tailed deer

Dave Ramsey (Dan O'Brien, Steve Schmitt, Graham Hickling)
Arthur Rylah Institute, Australia; Wildlife Disease Laboratory MDNR;
University of Tennessee at Knoxville

Since its discovery in the mid 1990s, bovine TB in wild deer continues to pose a risk to humans and livestock in the NE Lower Peninsula of Michigan. Current deer management in affected areas consists of increasing hunting pressure and restricting supplemental feeding.

While these strategies have been effective, there is a need for more focused control efforts and better refinement of management targets. This includes: (1) refinement of density targets (i.e. hunting pressure); (2) duration of control efforts; (3) spatial scale of control efforts; and (4) the possible use of vaccination in the control effort.

Modeling has been used to develop disease control strategies for complex biological systems. To be useful, the model must include information about the area, deer behavior, how the bacteria interacts with animals and the environment, and the random occurrence of events. Since bovine TB in deer is highly dependent on deer-to-deer interactions, the model must be able to mimic the local behavior of disease. A model called an individual-based model (IBM) meets the requirements and has been used in New Zealand to better understand eradication and control efforts.

In New Zealand, brush tail possums are the main wildlife reservoir for bovine TB. Possums are highly susceptible to the infection and rapidly develop lesions in the lymph nodes of the armpits and groin. Culling is the main disease control strategy and trapping is used to assess control efficacy. Modeling has been used to define targets for controlling TB in possums by culling. The threshold density required to eradicate TB was determined to be approximately half of the carrying capacity.

A model similar to that used in New Zealand in the TB eradication effort could provide useful information for Michigan's effort to eradicate bovine TB from wild white-tailed deer.

Management of Bovine Tuberculosis in Minnesota's Wild Deer

Michelle Carstensen
Minnesota Department of Natural Resources

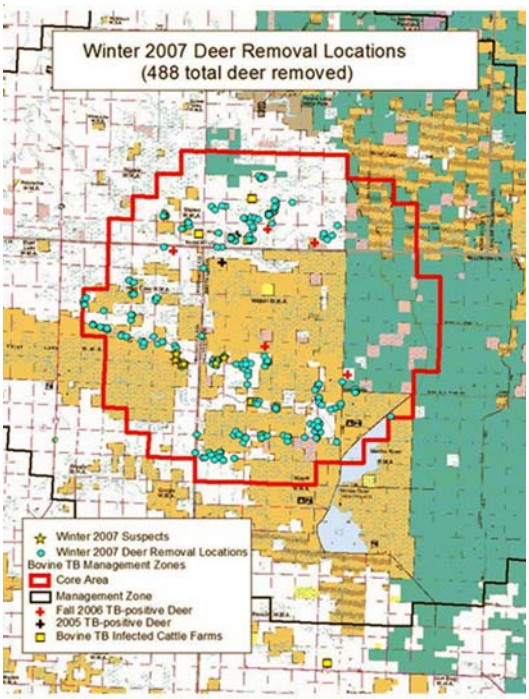
In 2005, a TB-infected deer was found in northern Minnesota. USDA required that 3,000 deer be sampled and examined for bovine TB. Sampling was based on deer density and distribution, as well as proximity to the TB zone. Of the 3,077 deer examined, 18 bovine TB-infected deer were identified. This results in a low annual prevalence of disease of 0.2 to 0.5 percent. All TB-infected deer were found within a 164 square mile core area.

"Alive in 2005" describes the fact that all 18 confirmed TB-infected deer would have been born by June 2005, suggesting that new infections are not common. This includes 16 deer older than two-and-a-half years, two deer that were one-and-a-half year old in 2006, and eight suspect TB cases from 2008 (seven adults, one yearling).

Wild white-tailed deer infected with bovine TB serve as a reservoir of TB infection for domestic cattle. The goal of the state is to eradicate bovine TB from wild and domestic animals. Components of the eradication effort include efforts to reduce deer densities, restrictions on recreational feeding, and using wildlife risk mitigation techniques. Special hunts, sharp shooters, landowner shooting permits, and aerial gunning are the methods used to reduce deer densities. Recreational feeding of deer is banned in certain areas. Risk mitigation at the cattle-deer interface utilizes the deer-proof fencing program.

The goal of the fall 2007 hunting seasons was to reduce deer densities in critical areas. This effort involved a new bovine TB permit area, early antlerless hunt, unlimited $2.50 bonus permits for antlerless deer, a venison donation program, and a special January hunt.

The winter (Feb-Apr) 2007 Deer Removal Project was successful in decreasing the deer density. In the core area, 488 deer were removed (42-63 percent of deer population). All deer were tested for bovine TB and six positives were identified.



The "Sharpshooting and Aerial Deer Removal Project Winter 2008" was another technique used to decrease deer density. Sharpshooters removed 546 deer, 416 deer were removed by aerial gunning, and an additional 125 deer removed by land owners. This project shows the power of cooperation between groups whose goal is to eradicate bovine TB. All deer were sampled for bovine TB and eight suspects were identified; confirmatory test results are pending.

Future plans include "Stay the course!"

- Keep pressure on deer to keep densities low through liberalized hunting this fall
- Conduct surveillance in TB zone and wherever else USDA might require for Split-State-Status
- Conduct another survey of deer numbers in the TB core in January, 2009
- Depending on outcomes of deer sampling in fall and survey results, another intensive deer removal effort may begin in winter 2009
- Continue to enforce the recreational feeding ban
- Continue to coordinate all efforts with BAH, MDA, and USDA

Riding Mountain National Park (RMNP) Wildlife Health Program 2008

Doug Bergeson (Todd Shury, Tim Sallows)
Parks Canada, Manitoba

The Riding Mountain National Park (RMNP) Wildlife Health Program involves the following programs: surveillance, research, prevention, and control. Surveillance occurs through the ongoing examination of hunter-killed samples, which continues to refine the geographic distribution of bovine TB in the elk and deer populations. One current research initiative in RMNP involves the use of proximity collars on elk. The main objective of this study is to determine individual contact rates between males and females and whether there are differences between individuals from various sub-populations. Hay yard barrier fencing and continued enforcement of baiting and feeding of wildlife make up the prevention component. Control occurs primarily through hunting of elk and deer outside of RMNP and test and removal of suspects using various blood tests within RMNP.

The elk population in RMNP has decreased since 1976 and it is now estimated at approximately 2,300 head. In 2008, the RMNP wildlife laboratory examined 135 hunter-harvested elk and 557 hunter-harvested deer, bringing the total number examined to 3,000 elk and 5,500 deer. The 2008 blood test and removal program within RMNP captured 152 elk, including 99 in the western section of RMNP and 53 in the east side of the Park. The western area of RMNP is where most (90 percent) of the bovine TB has been identified in wildlife. In addition, 59 white-tailed deer were also captured and blood tested. Based on the blood tests, 35 elk and eight deer were removed for further testing. Five elk (four bulls, one cow) and one deer were determined to be culture positive for bovine TB. All TB-infected elk were from the western part of RMNP and the TB-positive deer was located adjacent to western area of RMNP.

A total of 40 elk (22 bulls and 18 cows) have been confirmed with bovine TB since the first positive elk in 1992 – 28 as a result of blood test program, nine from the hunter harvest program, and three from opportunistic collection. A total of eight deer (seven bucks, one doe) have also been found infected with bovine TB. The majority (80 percent) of infected elk have been three or more years of age. The apparent prevalence rate of bovine TB in elk in the western area of RMNP is approximately six percent. Seven of the eight positive deer were over three years of age and the apparent prevalence rate of bovine TB in deer is less than one percent.

Over the next year, the goal in RMNP is to develop and implement an Elk/Deer Control Area (western RMNP), a Test and Remove Area (central RMNP), and a surveillance area (eastern RMNP).

Evaluation of blood based assays for bovine TB in elk

Todd Shury
Parks Canada, Saskatoon, Saskatchewan

Being able to identify TB-positive animals in the field, by a blood test, would be a useful way to improve management of infected wildlife. To date, however, the blood tests have not been fully characterized and validated. Four serological assays were evaluated: lymphocyte stimulation test (LST), a fluorescent polarization assay (FPA), a lateral flow immunoassay (Rapid Test), and a multi-antigen print immunoassay (MAPIA). An elk was considered positive if it reacted on one or more of these four tests.

A total of 557 elk were tested. Elk were captured by helicopter net gun and fitted with VHF collars. The VHF collar allowed tracking of the elk after release. Blood samples were taken from each elk. Any elk positive on any of the four tests was recaptured and euthanized. A complete necropsy was conducted and multiple lymph node samples were collected for culture, PCR, and histopathology. Animals were considered TB-positive if pooled lymph nodes were culture positive or were positive on PCR on lymph node tissue.

LST had best overall single test performance, however it is a laboratory-based test and there are technical difficulties with logistics getting samples to the laboratory. The Rapid Test (RT) is an antibody assay that detects antibodies to *M. bovis* in a cassette format. RT had highest specificity on evaluation of tests in a positive elk population and is useful as a field test. Combining tests will increase sensitivity and specificity.

Well-characterized, bovine TB-positive blood from elk and deer, as well as other cervids, is very, very scarce and it is very expensive to experimentally infect cervids. Jeffrey Nelson, USDA Veterinary Services is starting to build serum bank for cervid and cattle test development. He currently has ~1,500 samples. This will allow development of a common protocol for sample characterization and greatly enhance the ability to characterize bovine TB blood tests.

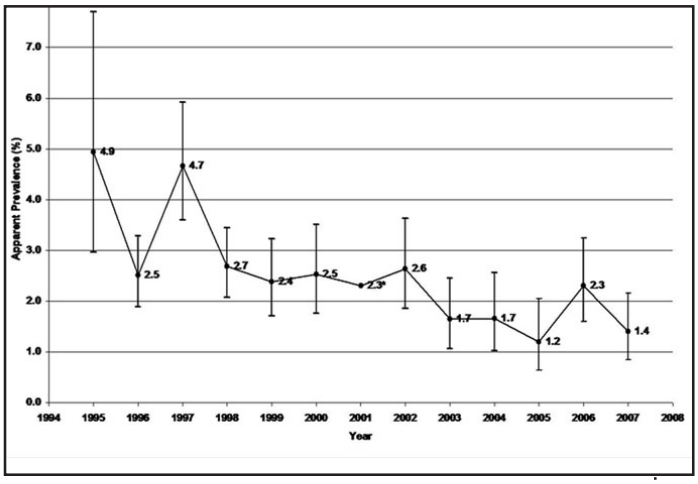
Wildlife surveillance and management update

Stephen M. Schmitt (Dan O'Brien, Graham Hickling)
Michigan Department of Natural Resources

The goals of the Michigan Department of Natural Resources (DNR) surveillance and management programs are to promote optimum health of Michigan's wildlife resources, while working toward eradicating bovine TB.

Both wild elk and white-tailed deer from northern Michigan have been infected with bovine TB. Michigan has an elk population of approximately 1,000 head and since 1996, there have been five TB-infected elk. It is believed that elk are spillover hosts for bovine TB. Since 1994, over 162,000 wild white-tailed deer have been tested for bovine TB, with 598 infected with bovine TB. **Most of the infected deer have been found in DMU-452**. One outlier deer was found in Shiawassee county and a second near the five county area in Iosco county. Active surveillance is ongoing in the five county area, the entire Modified Accredited Zone (MAZ), as well as the ten mile radius around the Shiawassee and Iosco County TB-infected deer. Active surveillance, involving fewer deer, occurs in the rest of the Lower Peninsula and passive surveillance involving hunter-killed deer will also continue.

The bovine TB eradication strategy is two-fold: (1) keep deer from concentrating by eliminating supplemental feeding and baiting; and (2) reduce deer numbers through hunting to a level supported by the natural vegetation. Feeding and baiting increase the deer population in an unnatural way.



In DMU-452, the apparent prevalence of bovine TB in deer has decreased from 4.9 percent in 1995 to 1.4 percent in 2007. Thus, there is a decreasing trend in the apparent prevalence in DMU-452. The apparent prevalence in yearlings has also decreased. Although there has been some fluctuation, the apparent prevalence in the five county area outside DMU-452 is the same as in 1996, 0.2%. The average annual rate of new infections declined 48 percent from 1995 through 2006.

Efforts to decrease the deer population by 50 percent in the five county area were initially successful, as the estimated deer numbers declined from 160,000 in 1995 to 80,000 in 2004. **However, the population is slowly rising and is approaching 120,000.** This is likely due to a statewide decline in the number of hunters, as well as hunters less willing to take deer when they don't see what they feel is an appropriate number of deer.

A cooperative effort between DNR and USDA-Wildlife Services involves trapping and testing deer for TB with the rapid test. Deer can be successfully captured and field-tested for TB. TB-infected deer can be detected. However, this is a time intensive and expensive process. Developing an effective vaccine for TB in deer is the focus of ongoing research. The ability to vaccinate negative deer before release would significantly aid Michigan's TB eradication efforts. But, before a TB vaccine could be used, three questions need to be answered:

- Is the vaccine efficacious?
- Is the vaccine safe?
- Will the vaccine cause problems with cattle testing?

Michigan is making progress in eradicating bovine TB from the state's deer herd. However, the state cannot back off on our eradication strategies and must develop more tools to help with the goal of eradicating bovine TB.

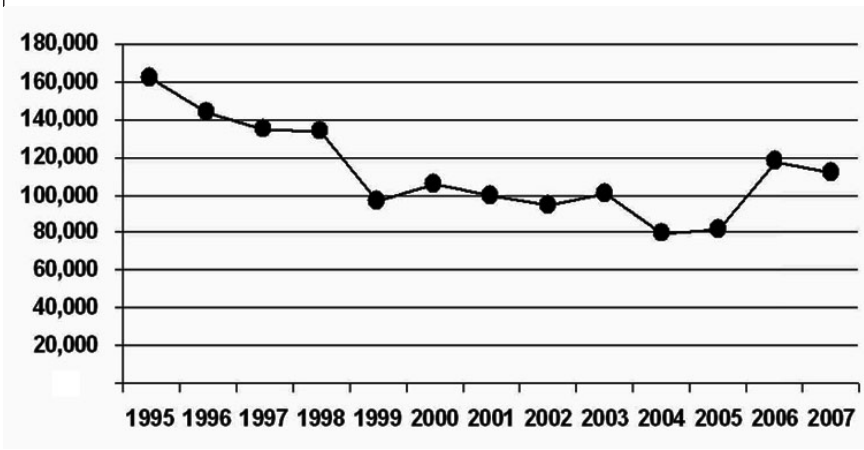
Deer population estimates; hunting, and harvest trends in northeast Michigan

Sara Schaefer
Michigan Department of Natural Resources

The DNR's goal is to manage the deer herd using science-based management practices. These goals would include maintaining healthy deer and keeping the population within the limits dictated by carrying capacity of the range. This must be accomplished while also considering the effects on native plant communities, agricultural, horticultural, silvicultural crops, and public safety.

Maintaining an active public information program is necessary to emphasize the importance of healthy deer and to acquaint the public with the methods of deer management and the conditions needed to maintain a healthy, vigorous herd.

Major emphasis recently has been on removing conditions that concentrate deer, including eliminating feeding and baiting of deer. Increasing the deer harvest will reduce the deer population (and potential to transmit disease) by decreasing close contact. The best implementation of strategy for decreasing deer numbers is by hunting during fall and winter. Evaluation of hunting participation and harvest trends as well as deer population estimates and trends will help to shape future policy.



We have used a variation on our common Sex-Age-Kill or SAK technique to generate deer population estimates for the five county area. The SAK technique uses data on the sex and age composition of deer compiled at annual check stations in combination with an estimate of the total buck harvest in the area to reconstruct or model the population that was present at the start of the prior hunting season. The two most recent population estimates of deer populations as of October 2006 and 2007 have both been in excess of 110,000 deer.

There were initial concerns that hunters might avoid the TB area due to the baiting ban established in northeast Michigan. Despite this, TB area and statewide trends in hunting effort, as indexed by the reported number of hunters and days invested in firearm deer hunting, have been very similar from 1996 to the present.

In the five county area, there is an overall declining ten year population trend, which has stabilized below mid-1990s levels. However, recent estimates are at or above early 2000s levels. DNR views further deer reductions will be challenging since surveys and other input clearly indicate the hunting public is not supportive of further decreases in the deer population.

Wildlife risk mitigation project

Tim Wilson
USDA Wildlife Services

The goal of the Wildlife Risk Mitigation Project is to help producers reduce the risk of spreading bovine TB from wildlife to cattle. **Reducing the risk involves herd specific wildlife risk mitigation plans.** The risk assessment program has evolved since 2005; the current approach is broader and is called Wildlife Risk*A*Syst Project. This project, organized by MDA, involves collaboration and cooperation from USDA Wildlife Services, USDA NRCS, local Conservation Districts, MDNR, MSU Extension, Michigan Farm Bureau, and local producers. It is modeled after the Michigan Agriculture Environmental Assurance Program (MAEAP) and links wildlife risk mitigation strategies with potential sources of funding.

The first step in the program is the assessment of wildlife risks, which includes location of the farm and general management practices. Specific attention is paid to winter feed areas, feed storage areas, water sources, and wildlife. After risk has been assessed, a farm specific risk mitigation plan is developed. This cooperative effort between WS and local Conservation District identifies risk mitigation practices and which practices might be eligible for funding through NRCS EQIP or MDA. To date, draft risk assessments have been completed on six farms. Once the assessments are finalized the plan will be implemented and verified.

Bovine TB public health implications

Melinda J. Wilkins
Michigan Department of Community Health

Bovine TB belongs to a group of bacteria called *Mycobacteriacea*. These bacteria are gram positive, aerobic, non-spore forming, non-motile, and slightly curved or straight rods. They are able to survive for weeks to months on inanimate objects protected from sunlight. They are also more resistant to acids, alkalis, and some chemical disinfectants than other non-spore forming bacteria.

Mycobacterium bovis (Bovine TB) is a well known zoonotic disease and all warm-blooded animals are considered susceptible. Humans can become infected from animals, and transmission from animals to humans has been documented. Human infection has been documented to occur from infected cattle, goats, deer, elk, buffalo, sheep, and camels. Human exposure to the bacteria occurs under a variety of circumstances, primarily aerosol inhalation and ingestion of the bovine TB bacteria. Aerosol exposure occurs at the farm, in the laboratory, or in the slaughterhouse. Consumption of unpasteurized milk, cheese, and other products from infected animals can result in exposure to bovine TB, and direct, cutaneous exposure is seen in butchers and hunters dealing with infected animals.

In the United States, bovine TB was virtually eliminated as a human pathogen by the Pasteurized Milk Ordinance (PMO) of the 1920s. The PMO required that milk be pasteurized. However, bovine TB remains a human health issue in countries where pasteurization of milk is not routinely practiced.

Historically, Michigan's cattle were certified free of bovine TB in 1979. However, in 1994 a wild white-tailed deer from northern lower Michigan was identified as being infected with bovine TB. A second infected deer was found in 1995, and infected cattle herds soon followed. The first recent human case was identified in 2002. The multi-

agency investigation found that several new species of animals infected with bovine TB, including deer, wild carnivores, scavengers, rodents, and one domestic cat. The diversity of infected species creates several potential new routes of transmission to humans.

Domestic pet project: Contrary to Federal recommendations, in Michigan, pets are allowed to remain on an infected farm following livestock depopulation, raising the question "Can domestic pets transmit bovine TB to humans?" This study was designed to retrospectively determine whether dogs and cats from infected farms are infected and if they pose a risk to humans. Five dogs and 18 cats were involved in the study. There was no physical, clinical, radiographic, or laboratory evidence that any of the pets were infected with bovine TB. **The risk of transmission from pets to humans is low.**

Epidemiology of *M. bovis* in Michigan Residents: This study involved Michigan residents diagnosed with bovine TB from 1995 to 2007 and focused on genetic and epidemiologic association with the current outbreak in cattle and deer. **Even with the TB outbreak in cattle and deer, there has been no increase in bovine TB in humans in Michigan.** Of the 13 cases, two were linked to the strain of bovine TB in cattle and deer – one was pulmonary and the other cutaneous and related to gutting an infected deer.

Based on CDC definitions, these two human cases are part of an epidemiologically-confirmed genotyping cluster. Deer have been confirmed as a source of human infection with bovine TB. Hunters can be exposed and infected via the cutaneous route of exposure. Thus, recreational exposure to infected deer in Michigan poses a potential, albeit low, risk for acquisition of *M. bovis* in humans.

Public health response to endemic bovine TB

Peter Davidson
Michigan Department of Community Health

In Michigan, the bacteria responsible for most cases of human tuberculosis (TB) is *Mycobacterium tuberculosis* (*M. tuberculosis*). Annually, the Michigan Department of Community Health (MDCH) receives over 200 case reports of TB caused by *M. tuberculosis*. The causative agent of bovine (cattle) TB is *Mycobacterium bovis* (*M. bovis*). The primary way bovine TB is spread to humans is by unpasteurized milk. With widespread pasteurization of milk, *M. bovis* rarely causes human disease in Michigan or the US. From 1998 to 2007, MDCH received ten case reports of bovine TB in humans.

In response to human exposure to bovine TB, the Michigan Department of Agriculture (MDA) notifies MDCH, who in turn notifies the appropriate local health department(s). Local health departments are responsible for education and performing skin tests for TB, known as the tuberculin skin test (TST). Of the 44 TB-infected cattle herds, follow-up data for the people involved is complete for 33 herds. Eleven of 41 individuals refused to have a screening TB test. Of the 30 people tested, two gave positive TST results. All people with positive TST results are evaluated for prophylaxis or treatment. If transmission of human tuberculosis is suspected, the local health department will investigate, assess the environment and circumstances of the suspected transmission, and attempt to identify and locate contacts. Contacts will also be offered a TST to determine whether they were infected as a result of their exposure.

Education and outreach involves collaboration with many agencies and the private sector. Producers are taught strategies to keep cattle free of *M. bovis*, how to break transmission among deer and between deer and cattle, and how to respond if *M. bovis* is detected in their cattle. Hunters receive information on avoiding or mitigating risks (e.g., handling and cooking).

http://www.michigan.gov/emergingdiseases
http://www.michigantb.org
http://www.michigan.gov/tb

M. bovis: a clinical perspective

James Sunstrum
Consultant for Michigan Department of Community Health

Although infection with *Mycobacterium bovis* is a major problem worldwide, in the United States it causes a much smaller proportion of human cases of tuberculosis. A recent article published in Clinical Infectious Disease "Human Tuberculosis due to *Mycobacterium bovis* in the United States, 1995-2005" describes 165 cases of *M. bovis* infections in humans in the US. This amounts to less than two percent of the total tuberculosis in people in the US during this time period.

***M. bovis* transmission in people is primarily the result of ingesting unpasteurized dairy products, including cheese.** Unpasteurized milk products, from cows or goats, are readily available in many areas. Approximately 30 percent of milk produced in Mexico is not pasteurized. Some Mexican dairy herds have bovine TB, and thus there is the potential for milk and dairy products from these herds to be contaminated with the *M. bovis*.

In 2004 a US-born boy aged 15 months died in New York City of peritoneal tuberculosis caused by *Mycobacterium bovis*. The case was traced to unpasteurized cheese *not* produced in the US.

In 2005, a 34-year-old Mexican male in Michigan presented with bilateral neck swelling. He was found to have tuberculosis caused by *M. bovis*. After the usual treatment failed, it was discovered that the patient had HIV/AIDS. This Michigan case parallels the world experience where **HIV/AIDS is unmasking *M. bovis* infection.**

Worldwide, most laboratories do not specifically identify *M. bovis* when a Mycobacterium species is cultured, thus the importance of *M. bovis* in human health worldwide may be underestimated. Survey of tertiary hospitals caring for HIV/AIDS patients found 19 percent of active TB cases were caused by *M. bovis.*

References:

Human Tuberculosis due to *Mycobacterium bovis* in the United States, 1995-2005 Clinical Infectious Disease, 2008:47, 168-175

Epidemiology of *M. bovis* disease in San Diego County, 1994-2000. Int J Tuberc Lung Dis 2003: Feb. 7:180-5

Treatment of *M. bovis* infected tuberculosis patients: San Diego County, California, United Stated 1994-2003. Int J Tuberc Lung Dis 2005: March. 9:333-8

HIV/AIDS and its implications for the control of animal tuberculosis. Br. Vet J. 1993; 149:405-417

Mycobacterium bovis tuberculosis: from animal to man and back. Int. J Tuber Lung Dis 2004; 8:903-904

MSU Extension – a valuable partner in the battle against bovine TB

Phil Durst
MSU Extension

The mission of MSU Extension is to "Help people improve their lives through an educational process that applies knowledge to critical issues, needs and opportunities." MSU has Extension Educators in every county - educators that care about "their" counties and who work to meet local needs.

One important role of MSU Extension is communication of practical, accurate, sound, research-based information. This is accomplished in many ways including county, district, and statewide newsletters. Bovine TB News is a monthly, electronic newsletter that includes information on bovine TB in Michigan and the U.S., as well as research updates. Additional ways to provide information include farm visits and meetings.

MSU Extension also provides a comprehensive approach to issues. When working with farm families, Extension utilizes a team approach to examine farm management, family financial aspects, and the overall industry. MSU Extension also works with owners of depopulated herds to assess wildlife disease risks and review potential enterprises and alternatives, and prepare financial projections of alternatives.

Starting with youth programs, Extension fosters the development of leadership and decision-making skills. Adult programs are about expanding the horizon of alternatives and helping people consider the consequences of various courses of action. Extension also serves as a coalition builder and team player. This aspect of Extension is very important since the bovine TB issue necessitates partnerships, cooperation, and teamwork.

Extension works with a wide range of stakeholders: hunt clubs and land owners, local businesses, government and producers.

The goal of MSU Extension is to discover and implement solutions to move people to act to accomplish their goals.

TB is a marathon. Extension educators are continuing to work with people on a local level, but there is an opportunity to do more together. MSU Extension wants to continue to be a valuable partner on this issue.

Aerosol inoculation of opossum and lateral transmission of *M. bovis*

Karla Mesterhazy (Scott Fitzgerald, James Sikarskie, Konstantine Lyanschenko, John Kaneene, Steve Church, Dale Berry)
Department of Pathobiology and Diagnostic Investigation, MSU

The *Mycobacterium tuberculosis* complex consists of five species, including *Mycobacterium bovis* (*M. bovis*), the causative agent of bovine TB. In the United States bovine TB is reported sporadically in multiple states, but most notable is the endemic focus of *M. bovis* in the wild deer population in northern Michigan. The brush tail opossum has been identified as a wildlife reservoir for bovine TB in New Zealand and has been proven to be a significant contributor to infection for cattle and deer. The brush tail opossum is an ideal reservoir based on susceptibility, multiple routes of organism shedding, and the close interspecies contact in shared dens. **This study investigates the role of the North American opossum (*Didelphis virginiana*) as a possible wildlife reservoir.**

The specific aim of this project is to determine if wild mammals other than deer are shedding *M. bovis* and contributing to the spread of disease. The study is designed to determine if transmission by direct contact will occur between infected and non-infected wild opossums.

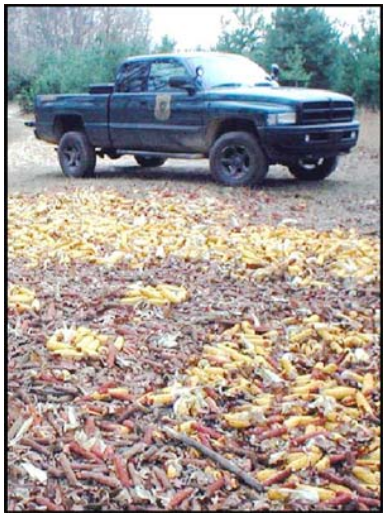
This study was performed in a biosafety level three facility. Twelve wild opossum joeys were used in the study: four were infected with *M. bovis*, four were exposed to the infected joeys and four were housed separately and served as controls. All animals were monitored daily and fed dry cat food and water with weekly supplements of apples or moist cat food. Eighty-four days after the beginning of the experiment, animals were euthanized and a complete post-mortem examination was performed.

Infected opossums had marked multifocal, granulomatous pneumonia, increased lung and liver weight, and evidence of bovine TB in their tissues. The exposed and control groups had no major gross lesions and bovine TB was *NOT* detectable in their tissues. In this experiment there was no significant lateral transmission of bovine TB between infected and non-infected wild opossum, **therefore there is little risk for natural spread of the disease between individuals of this species.**

Stakeholder acceptance: criminological theory, compliance, and cooperation

Brent Rudolph
DNR Wildlife Division & Department of Fisheries and Wildlife MSU

Since we know that the spread of bovine TB is greatest when deer congregate in large numbers, key questions include: "Why do deer hunters choose not to comply with baiting regulations and cooperate with efforts to reduce deer densities?" An important consideration is that hunting is generally a solitary activity, conducted without the opportunity for actions to be condoned or condemned by others. As Aldo Leopold, regarded as the founder of the profession of wildlife management wrote, "A peculiar virtue in wildlife ethics is that the hunter ordinarily has no gallery to applaud or disapprove of his conduct. Whatever his acts, they are dictated by his conscience, rather than by a mob of onlookers. It is difficult to exaggerate the importance of this fact." Hunter compliance, however, has been little studied. **The need to understand factors contributing to compliance and cooperation is especially important as the state moves into the second decade of the TB eradication efforts.**



The Michigan Department of Natural Resources has approached TB eradication through several management interventions. Hunting regulations have been liberalized, especially pertaining to antlerless deer. In addition, there have been restrictions on baiting and feeding deer. This includes a complete ban on baiting and feeding within northeast Michigan, an area where these activities have traditionally been widely practiced.

One aspect influencing compliance with regulations may be conceived of as a cost-benefit analysis between deterrence and illegal gains. Costs are represented by the risk of being caught and punished and benefits by the additional profit or opportunities associated with non-compliance. **Normative influence, a sense of internal duty to comply, is another important consideration.** Normative influence may occur through moral obligation, social norms, and perceived legitimacy of regulations or responsibility to authorities. A variety of information is available to assess the potential influence of these factors on hunter behavior in Michigan.

In Michigan, deterrence is represented by the $500 maximum fine that can be imposed by the court and an enforcement capacity that is limited to nearly 5,000 deer hunters per conservation officer. Surveys have revealed that perceived gains from using bait include baiting to get deer to pause in a place where deer are naturally found (distracters, 47.6 percent of Michigan hunters surveyed), drawing deer to the hunter (attractors, 28.7 percent), or bringing and keeping deer at a baiting location (concentrators, 18.5 percent). Risk of enhancing disease spread increases from the former to the latter. In terms of moral norms, 22.4 percent of Michigan hunters surveyed in 1999 believed that baiting should be banned because it is unethical, while 16.5 percent felt it should never be banned. Acceptance of others' use of bait has increased in successive surveys over the past several decades, and was most recently greater than 60 percent, indicating little to no social norm against baiting.

Deterrence, illegal gains, and moral and social norms are difficult and/or expensive to influence. A factor which has remained unexplored and holds some potential for increasing compliance is the normative influence of legitimacy. Criminology research has indicated that adopting elements of procedurally just processes – including participation, neutrality, trustworthiness, and treatment with dignity and respect – can enhance compliance with regulations as well as cooperation with agencies (which in this case could translate to increased efforts to reduce deer densities). **The goal of this project is to evaluate the influence of deterrence, illegal gains, and normative influence on hunter decisions to comply and cooperate with TB eradication.** The relative importance of these factors will be evaluated separately for key groups in the TB area using data collected through face-to-face questionnaires and interviews.

** Editor's note – on October 9, 2008, feeding and baiting was banned indefinitely in the entire Lower Peninsula following the discovery of a Chronic Wasting Disease-infected deer at a Kent County cervid facility.*

Summary of interdisciplinary bovine TB research at MSU

John B. Kaneene
College of Veterinary Medicine, MSU

Michigan State University has been involved in bovine TB research spanning biomedical sciences, wildlife ecology, and social sciences. Research involves an interdisciplinary approach and collaboration with state and federal agencies. In addition to increased knowledge as a result of the research summarized here, several graduate students, our next generation of researchers, have received practical training and experience.

There are three broad areas of research focus: biomedical, wildlife ecology, and social science. Biomedical research involves epidemiology studies, including risk assessment, surveillance and public health, as well as pathogenesis of disease and diagnostics. Wildlife ecology research involves deer ecology and behavior. Social science studies include economics, human ecology, and beliefs and attitudes. Research has been published in refereed scientific journals, technical reports, pamphlets, and leaflets. A summary of research studies follows.

Biomedical research: Epidemiology and Risk Assessment

Environmental and farm management factors associated with tuberculosis on cattle farms in NE Michigan
Increased risk - TB prevalence and wildlife attractants
Decreased risk - Poor deer habitat and excluding deer from premises
Conclusion: Biosecurity will reduce herd risk for TB

Development of on-farm risk calculator to estimate herd risk of TB and cost-benefit of risk reduction strategies
Farm risk model based on previous studies
Model validated through simulation
Conclusion: Tool for on-farm use to develop TB prevention programs

Geographic distribution and spatial analysis of Mycobacterium bovis infection in white-tailed deer
Spatial clusters of TB are associated with habitat that promoted congregation of deer for long periods of time
Conclusion: Identify locations where TB can be spread for wildlife TB control programs

Influence of supplemental feeding of white-tailed deer on the prevalence of bovine TB in Michigan wild deer
TB risk increases – Quantity of feed and good deer habitat
TB risk decreases – Poor deer habitat
Conclusion: Eliminate/reduce supplemental feeding of deer

Biomedical research: Surveillance

Modeling to estimate herd-level sensitivity, specificity, and predictive values of TB diagnostic tests for cattle
Current tests for detecting TB cattle herds work well
Herds with < 100 cattle should test more frequently
Conclusion: Improve effectiveness of surveillance protocols

Determining survival of M. bovis in environmental samples
M. bovis survived in farm substrates under Michigan weather conditions for six to ten weeks
Developed methods for culturing *M. bovis* from environmental samples
Conclusion: Information for premises decontamination

Development and application of molecular techniques for detection of *M. bovis* in environmental samples
Nested PCR primers developed
Effective for detection of *M. bovis* in soil samples
Conclusion: Improved detection for surveillance

Develop risk-based surveillance system for bovine TB testing
Sampling adjusted to herd management and geographic risk factors
Increase sampling in high risk areas, reduce in low risk areas
Conclusion: Development of more efficient and economical TB surveillance programs

Biomedical research: Public health

Human M. bovis infection and bovine tuberculosis outbreak
Two human cases of *M. bovis* in Michigan born residents
Epidemiologic and molecular links to deer/cattle outbreak strain
Conclusion: Demonstrated public health risk of bovine TB in Michigan from animal reservoir

Injuries associated with bovine TB testing livestock in Michigan
Injuries resulting from livestock testing in veterinarians, farmers, farm workers
Frequency and severity of injury
Conclusion: Degree of health impacts for regulators, policymakers

Absence of M. bovis infection in dogs and cats residing on infected cattle farms in Michigan
No infection in 18 cats, five dogs from affected cattle farms
Conclusion: Pets are not a major risk for zoonotic *M. bovis* infection

Biomedical research: Disease Pathogenesis

Experimental inoculation of wild birds
Starlings, crows, pigeons, mallard ducks, turkeys
Pigeons moderately susceptible, shed organisms for at least 60 days
Conclusion: Pigeon control may be important for cattle farms

Experimental inoculation of rodents
Norway rats, meadow voles, wild house mice
Voles and house mice highly susceptible to *M. bovis*
Conclusion: Importance of rodent control

Experimental inoculation of other wildlife
Opossum highly susceptible but does not transmit readily
Conclusion: Opossums are spillover hosts and not reservoirs of TB

Efficacy of M. bovis vaccination using RB51 subunit vaccine and BCG
BALBc mice with BCG, RB51 subunit vaccine
BCG more effective than RB51
Conclusion: Vaccine development for livestock, wildlife reservoirs of TB

Biomedical research: Diagnostics

Retrospective study of Johne's Disease and false positive TB tests in cattle. Effect of M. paratuberculosis infection on caudal fold skin test and gamma interferon assay for TB in cattle
Less than 1.5% of false reactors had evidence of Johne's disease
No cross-reactivity with gamma interferon assay
Non-significant increase in false positive CFT
Conclusions: No significant associations between Johne's disease and false positive TB tests

Comparison of post-mortem techniques for the detection of* Mycobacterium bovis *in white-tailed deer
Compared histopathology, acid-fast staining in culture, group-specific genetic probe
Gold standard: mycobacterial culture and identification
Conclusion: Group-specific gene probe may be used as new 'gold standard' for TB detection

Wildlife Ecology

White-tailed Deer Behavior and Movement
Described deer feeding behavior and potential for TB transmission at baiting and feeding sites
Tracked and quantified deer migration and dispersal
Effects of habitat on feeding and movement
Conclusions: Information for models to predict wildlife TB and DNR feeding and baiting regulations

***Genetic relatedness and the spread of bovine* TB**
Contacts between related deer within social groups contribute to TB transmission
Supplemental feeding eradicated spatial genetic structure
Conclusion: Information on TB transmission within family groups, for feeding/baiting regulations

Social Sciences

Attitudes, Behavior, and Effort of Hunters in Bovine TB Areas of Michigan
Quantified hunter contributions to economy
Hunting site location choices based on deer density, public hunting land, economic considerations
Conclusion: Understanding hunters' motivation and economic contributions, for policymakers

Economic Consequences of Bovine TB for Michigan Livestock Agriculture
Valued losses due to herd depopulation
Decision-making (costs, incentives) when TB present
Conclusion: Understanding full economic consequences of TB at farm level

The impact of bovine TB on the farm family ecosystem, and sustainability of farming after TB diagnosis
Lower satisfaction with family life
Lack of information, poor communication
Policies, enforcement: insensitive and unexpected
Conclusion: Impact on families, and farmer attitudes that will affect compliance with TB control programs

Farmers' attitudes and behaviors related to transmission of Bovine TB to cattle
Case-control study of farmers with/without TB
Groups differed on importance of wildlife biosecurity and use of wildlife control permits
Conclusion: Understanding whether farmers' attitudes transfer to behaviors that reduce TB risks

Attitudes, Behavior, and Effort of Hunters in Bovine TB Areas of Michigan
Overall decline in hunting regardless of TB in area
Hunting location mainly based on deer density
Different priorities between hunters in TB areas versus other areas
Conclusion: Understanding hunters' motivation to improve hunting industry in TB area

Reducing interactions between cattle and white-tailed deer in northern Minnesota

Scott Wells (Barbara Knust, Paul Wolf)
University of Minnesota & USDA-APHIS-Wildlife Services

Deer can infect cattle with bovine TB both directly and indirectly. Direct transmission involves close contact and sharing of respiratory secretions (saliva, sputum). Indirect transmission requires that cattle eat feed contaminated with bovine TB from deer saliva or sputum. Therefore, avoiding interaction between deer and cattle would be considered a key control point. This would include avoiding both direct contacts between animals, as well as not allowing deer to eat cattle feed.

This study was designed to answer the question **"What are the primary deer-cattle interaction risks on farms in northwestern Minnesota in the high risk time of year for *M. bovis* transmission and what steps can be taken to minimize the risk**?"

Fifty-three herds were involved: 51 cow-calf beef herds, one dairy and one dairy calf raiser. The mean size was 69 cows with a range of 20 to 250 head. Risk assessments were performed on farms in winter of 2008; risk assessments included interviews by a veterinarian and wildlife biologist. Information about both the cattle herd and wild deer on the farm was obtained.

Deer interactions were most common in the fall and 91 percent of farms reported using hunting as a way to decrease deer-cattle interactions. Half of all farms reported damage to stored feed, most commonly silage. Although there is no "safe" feed, the presence of attractive feed, including silage, alfalfa hay, and beet pulp, may bring deer onto the farm to eat other feeds. Feed storage is rated the highest priority for reducing deer-cattle interactions on 80 percent of farms studied. There is a high opportunity for deer-cattle interactions. Deer commonly damage cattle feed. Further evaluations are planned to better understand risks of deer-cattle interactions.

Bovine Tuberculosis in Minnesota: University of Minnesota Extension response

Grant Crawford (Ryon Walker, Lori Schott, and Alfredo DiCostanzo)
University of Minnesota Extension Beef Team

The proposed Modified Accredited Zone (MAZ) counties in Minnesota are in the northern most part of the state and include Beltrami, Lake of the Woods, Marshall, and Roseau counties. This four county area has 74,000 head of cattle, out of a statewide total of 2,400,000 head. **This is in contrast to Michigan that has 1,070,000 head statewide, with 49,800 in their current MAZ.**

Despite the fact that all extension agents are six or more hours away from the proposed MAZ, University of Minnesota Extension has a major role in the bovine TB response. Extension serves as unbiased, accurate source of information for Minnesota's beef producers and works with beef producers, industry, and agencies to develop and implement TB management and eradication efforts. In response to the bovine TB issue, Extension organized informational meetings throughout the state, coordinated Cow-Calf days, presented bovine TB management information at three locations of the Northwest Fall Beef Roundup, and had many coffee shop meetings. Many of the meetings were held in conjunction with Minnesota Department of Agriculture (MDA), the University of Minnesota College of Veterinary Medicine, USDA Wildlife Services, and the state Board of Animal Health (BAH).

Spayed heifers and steers (castrated males) can move throughout the state without TB testing. Castration of bull calves is often done on the farm, but spaying of heifers is rarely done in Minnesota. Because movement of sexually intact animals requires additional TB testing, Extension coordinated heifer spay clinics at three locations across the state. Bovine TB Management Meetings involved 450 producers in four locations and focused on management strategies to work with bovine TB including marketing, biosecurity, and fencing.

A survey done by the Minnesota Department of Agriculture was conducted at management meetings and included eight questions. Eighty-two producers responded, including 67 commercial and 14 Purebred beef producers, 22 stocker/backgrounder, and one dairy. This included 7,047 cows, 412 bulls, 146 fed cattle, 2,211 feeder cattle, 1,175 replacements, and 3,373 calves. Most were not in the proposed MAZ and most were not planning on getting out of the cattle business. Fifty-eight producers answered yes to the question "Would you consider using cost share to upgrade and improve facilities around winter feeding areas, pastures, etc. to protect animals from contracting disease?" Producers identified the following issues that need more focus regarding TB in Minnesota: (1) TB control in deer; (2) marketing of feeders /maximizing sale price; (3) cost share for TB testing; (4) feeding cattle in MN feedlots; (5) economic impact on feeder prices; and (6) shortage of veterinarians.

U of MN Beef Team Response Extension Programming continues with two additional spaying clinics, participation in Northwest Fall Beef Roundup, and involvement with the TB forum at FarmFest. Extension will continue participation in task forces, radio interviews, articles, cattlemen's meetings, etc.

Minnesota feedlot capacity is 305,000 head and growing. Traditionally, Minnesota cattle feeders have purchased cattle from the Dakotas, Montana, and Nebraska. NW Minnesota calves are generally lower priced, are perceived as being of lower quality and consequently sell to smaller lots. Extension has been instrumental in connecting NW Minnesota cow/calf producers with SW Minnesota feedlots. U of MN Beef Team Response will continue to work with MDA, MBAH, DNR, USDA, and UMN CVM and other organizations and agencies toward the ultimate goal of regaining TB free status.

Vaccination of white-tailed deer with *Mycobacterium bovis* BCG

Mitchell V. Palmer (Tyler C. Thacker, Pauline Nol, W. Ray Waters)
National Animal Disease Center, ARS, USDA, Ames, IA
National Wildlife Research Center, APHIS, USDA, Ft. Collins, CO

One of the things that would help us to eradicate bovine TB from wildlife reservoirs would be the development of a TB vaccine for wildlife. In order to be feasible, a wildlife TB vaccine must prevent infection and be easy to deliver to wildlife. It also must be safe for wildlife, domestic animals, humans, and the environment.

Lipid-formulated baits provided by Frank Aldwell, University of Chicago

Mycobacterium bovis bacille Calmette-Guerín (BCG) vaccine is the oldest human vaccine in use today. BCG was originally developed in the early 1900s from an isolate derived from a cow with tuberculosis. Several genetically distinct strains of BCG (i.e., Pasteur, Danish, Tokyo, Trice, etc.) have been developed from this original isolate. **BCG is the world's most widely used human vaccine (three billion doses since 1920).** Although the efficacy in humans is variable, it seems logical that BCG could be useful as a bovine TB vaccine for other mammals, including wildlife.

Several experiments were conducted to determine if BCG prevented TB in wild deer and if it could be safely delivered. Evidence of the effectiveness of the vaccine was determined by gross necropsy, microscopic examination of tissues, and tissue culture after infecting vaccinated and non-vaccinated deer with bovine TB.

In red deer, two doses of BCG protected against infection (presence of the bacteria) and disease (pathology associated with bovine TB). One dose protected against disease but not infection. Since spread of bovine TB is more likely in animals with disease this is an important distinction.

White-tailed deer were given one dose of oral BCG (Danish) vaccine in a lipid-formulated bait, and results compared to the vaccine given subcutaneously and a no vaccine group. **Vaccination with BCG Danish results in decreased lesion severity, suggesting that oral vaccination may be feasible in white-tailed deer.**

Humoral immune responses of white-tailed deer BCG vaccination and experimental challenge with *M. bovis*

Pauline Nol (K.P. Lyashchenko, W.R. Waters, M. V. Palmer, J.C. Rhyan, and M.D. Salman)
National Wildlife Research Center, APHIS, USDA, Ft. Collins, CO

BCG is a vaccine used world wide in humans against tuberculosis (TB). Vaccination could also be a useful tool to manage disease caused by bovine TB in wildlife. The following experiment was designed to determine if the BCG (Danish 1331) vaccine would prevent experimental bovine TB infection in deer. Sixteen deer were vaccinated with BCG (10 by mouth and six by injection) and six deer were not; all deer were infected with bovine TB. All six of the non-vaccinated deer developed visible evidence of infection, while only five of 16 vaccinated deer developed visible evidence of infection. Various blood tests (MAPIA, Rapid Test, and Immunoblot) designed to assess bovine TB infection ante-mortem were also evaluated. MAPIA and Rapid Test were generally not able to detect antibody responses in vaccinated white-tailed deer after challenge infection as opposed to non-vaccinated deer. Immunoblot suggested the occurrence of unique antibody responses by certain vaccine groups to specific proteins.

In summary, vaccination of white-tailed deer with BCG (by mouth and by injection) is effective in reducing disease caused by bovine TB as compared with non-vaccinated animals. Results from the tests support further investigation into the potential use of antibody-based assays, such as MAPIA and Rapid Test, as ante-mortem tools to assess disease progression in white-tailed deer in both controlled and field vaccine trials.

Oral vaccination of wild white-tailed deer may prove useful in the TB eradication effort. Further testing and development is needed to support the use of vaccination against bovine TB in wildlife.

Photo by James Fosse

Collaborators on this study include:
Pauline Nol, Jack Rhyan, and Mike Dunbar
USDA/APHIS Veterinary Services, Wildlife Services

Mitch Palmer, Ray Waters, and Brian Nonnecke
USDA/ARS National Animal Disease Center

Frank Aldwell and Bryce Buddle
University of Otago and AgResearch, New Zealand

Mo Salman, Joni Triantis, and Lyndsey Linke
Animal Population Health Institute, Colorado State University

Konstantin Lyashchenko, Rena Greenwald, and Javan Esfandiari
Chembio Diagnostic Systems, Inc., Medford, NY, USA

Preliminary evaluation of the potential shedding of *Mycobacterium bovis* by coyotes and raccoons

Mike R. Dunbar (Shylo R. Johnson, Are R. Berentsen, Lorene Martinez, Tim Riley, Robert L. Jones, Richard Bowen, Paul Gordy)
United States Department of Agriculture/APHIS/WS and Colorado State University

In Michigan, various wildlife species have been found infected with bovine TB, including white-tailed deer, black bear, bobcat, coyote, raccoon, red fox, and North American opossum. White-tailed deer shed bovine TB and transmit it to cattle, primarily by indirect contact via shared feed. In the United States, no other wildlife species has been shown to play an important role in the disease. If other wildlife species shed *M. bovis*, the potential for spread of the disease increase and control and eradication efforts become more complicated and expensive. These experiments were designed to determine if other wild species that are infected with bovine TB can shed the bacteria and transmit bovine TB to cattle.

There are a large number of coyotes and raccoons in affected areas of northern lower Michigan. Coyotes and raccoons interact with farms, cattle, and feed/water resources. The question is: Do coyotes and raccoons shed *M. bovis*?

Three studies were conducted – one captive study and two field studies. In the captive study, four coyotes were given a low dose of the bovine TB bacteria orally. To determine if coyotes developed bovine TB infection, samples were obtained for culture and histology. This study showed that coyotes are not susceptible to bovine TB (at the dose given), suggesting that coyotes are not involved in transmission of bovine TB to cattle. However, this dose may be much lower than the dose obtained by a coyote eating an infected carcass.

A 2003-2005 field study determined that the prevalence of bovine TB infection in coyotes in four counties in the MAZ ranged from 19 percent in Montmorency to 54.2 percent in Alcona. The 2007-2008 coyote prevalence study was done somewhat differently than the earlier study, and included counties with known bovine TB in coyotes (Alpena and Alcona), as well as negative counties and counties with unknown infection status. Because different counties were involved in the two studies, comparison can only be done for data from Alcona County. The prevalence of bovine TB in coyotes in Alcona County has not changed since 2003. The prevalence in the first study was 37.5 percent versus 30 percent in the most recent study; these numbers are not statistically different.

To date, 154 raccoons have been trapped, which is 75 percent of the goal. Only one tissue from one raccoon has been positive for an unidentified type of Mycobacterium, suggesting that the prevalence of bovine TB in raccoons is low.

Risk factors associated with transmission of bovine Tuberculosis from white-tailed deer to cattle in northern Michigan

Are R. Berentsen (Ryan S. Miller, Mike R. Dunbar and Regina Ebersole)
United States Department of Agriculture APHIS/VS & WS

Although bovine TB was widespread in cattle, historically it has been rare in US wildlife. Internationally, there are mammals that are considered a wildlife reservoir for bovine TB. Reservoir animals maintain the infection within their population and spread it to domestic and other wild animals. In the United Kingdom, the badger is considered the wildlife reservoir, while in New Zealand the culprit is the brush tail possum. **In Michigan, the primary wildlife reservoir for bovine TB is the white tailed deer.** It is known that bovine TB can be transmitted between deer and cattle, and the sharing of feed increases the chance of passing on the infection.

The objective of this study is to determine how much time deer spend on cattle farms, where they go within farms, and to see if there is a relationship between deer movement and management strategies. This information should be useful to identify measures that farmers can take to reduce the risk for bovine TB in their herd.

Participating farmers, in or near DMU-452, provided information on when they feed their livestock, what method they use, which pastures they use and for what purpose. For example, hay pastures vs. feeding pastures. This information will be used to correlate deer movements and management practices.

Deer are captured using collapsible clover traps baited with cracked corn, molasses and apples. Deer are physically restrained and fitted with an ear tag and a Global Positioning System (GPS) collar. The collars are programmed to take a location every two hours for one year. High resolution GPS is used to map farms, including the location of barns, fences, feeding areas, feed storage areas, etc. The information obtained will determine how much time deer spend on farms.

On average deer visited 62 percent of farms within their home ranges. This varied quite a bit, with four deer visiting only one farm, while a single deer visited 10 farms. Seven deer visited multiple farms on the same day, with three deer visiting as many as three farms in a single day.

A video display of deer movement shows that the first animal to appear heads SW immediately after capture and stays in that area for several days. The video shows that there is quite a bit of deer interaction, which could have implications for disease spread. In addition, collared deer are moving between farms with one deer visiting 10 different farms and another visiting three different farms multiple times a day for several days in a row. Again, this type of movement between farms has implications for potential disease transmission.

Overall deer use of cattle areas peaks in the early spring with a slight uptick in the fall. There is low use of feeding areas in the winter, which runs a bit counterintuitive as one would think deer would use these areas more frequently in the winter when natural resources are scarce.

The study is ongoing and data continues to be collected and analyzed. Data on deer movement into farms will provide information to mitigate the risk of bovine TB and suggest changes in farming practices to avoid potential contact with deer.

Are Berentsen
Are Berentsen has been a Wildlife Biologist in the Wildlife Disease Program at the National Wildlife Research Center for two years. He is a field research coordinator and manages three studies in northern Michigan and one in northeastern Ohio. He completed his Bachelor's degree in Zoology from the University of California, Davis and a Master's degree in Wildlife Biology from Utah State University. Prior to coming to the NWRC he studied coyotes in California and Utah, ground squirrels in California as well as black rhino and antelope in southern Africa.

Dr. Doug Bergeson
Doug Bergeson is a Conservation Biologist with Parks Canada in Riding Mountain National Park. Doug has worked for Parks Canada for 15 years, of which the last four have been in Riding Mountain. Doug's primary responsibility in Riding Mountain is wildlife research and management.

Dr. Michelle Carstensen
Dr. Carstensen received her BS in Animal Science from Cornell University, and both her MS and PhD in Wildlife Conservation from the University of Minnesota. In 1998, she began her graduate studies on nutritional and reproductive physiology of cervids, specifically effects of winter severity on body composition, reproduction and survival of white-tailed deer. Michelle joined the Minnesota Department of Natural Resources in 2004 and is currently the Wildlife Health Program Coordinator. She primarily works on emergent wildlife diseases in the state, including chronic wasting disease, bovine tuberculosis, and avian influenza.

Dr. Grant Crawford
Dr. Crawford is a beef feedlot extension educator with the University of Minnesota Extension Beef Team. As a member of the U of M Extension Beef Team, Grant has been involved in bovine TB outreach activities throughout Minnesota. Among these activities: participation in the University of Minnesota bovine TB task force, participation and coordination of Board of Animal Health TB meetings, and participation and coordination of University of Minnesota bovine TB meetings in northwestern Minnesota. Grant is also involved in research projects associated with bovine TB focusing on improving beef cattle systems to remain viable with a lowered bovine TB status. Grant is a native of Beaver Creek, MN, and received a PhD in animal science from the University of Nebraska, a MS in animal science from the University of Minnesota, and a BS in agricultural education from South Dakota State University.

Dr. Michael R. Dunbar
Dr. Dunbar is presently a Research Wildlife Biologist and Project Leader for Rabies and Bovine Tuberculosis Research at USDA/APHIS National Wildlife Research Center in Ft. Collins, Colorado. Dr. Dunbar earned his Masters degree in Wildlife Ecology at Oklahoma State University and his DVM at Washington State University. Before joining USDA, he was a Research Wildlife Biologist for the US Fish and Wildlife Service in Oregon and the Branch Chief for Diagnostics and Research at USGS's National Wildlife Health Center in Madison, Wisconsin. Dr. Dunbar has worked for various state fish and game agencies as a Conservation Officer, Wildlife Biologist, and Wildlife Veterinarian. Presently, he both conducts and oversees a large number of research studies on bovine tuberculosis at the wildlife/livestock interface in Michigan. Dr. Dunbar has nearly 30 years of experience working on national as well as international issues on health/nutrition, disease, and management of free-ranging wildlife.

Phil Durst
Phil Durst is the MSU Extension Educator for Dairy in NE Michigan. He has worked with the farm families in that area and with regulatory and academic professionals regarding the bovine TB issue for over 10 years. He is a member of the Michigan Department of Agriculture TB Advisory Committee and the US Animal Health Association TB Committee. Recently, he was appointed chair of a USAHA subcommittee to study TB Test and Remove policy and make policy recommendations. Durst is certified as a Professional Animal Scientist with the American Registry of Professional Animal Scientists.

Dr. James Earl
Dr. Earl is a graduate of Michigan State and had a mixed animal practice in mid-Michigan until he joined MDA in 2001. Earl moved to USDA in 2002 and became Assistant Area Veterinarian in Charge in 2005.

Dr. Steven Halstead
Dr. Halstead is a Michigan native with a rural agricultural background, living in SW Eaton County on 108 acres of farmland, woods, and muck. Halstead graduated from Michigan State University College of Veterinary Medicine in 1982 and was in private practice in Norway, Maine until 1984. He then moved back to Michigan as a resident in Large Animal Surgery and Medicine and a graduate student in Microbiology. In 1990 he became a field veterinarian working on the pseudorabies eradication program for MDA. From 1994 through 2004 he was the MDA veterinarian for equine and companion animal programs. Since 2004 Halstead has been the State Veterinarian and MDA Animal Industry Division Director.

Dr. Dan Harpster
Dan graduated from The Ohio State University College of Veterinary Medicine in 1985, practiced in a mixed practice for a short time, worked for Food Safety and Inspection Service, USDA, for a year-and-a-half, and began working for Veterinary Services, Animal and Plant Health Inspection Service, USDA in 1988. Dan has held one headquarter and four field positions in his 20 years with Veterinary Services. Dan is currently the VS Area Emergency Coordinator for the states of Ohio/West Virginia, and Michigan. Dan currently serves as the Liaison Staff Officer on the Veterinary Services National Incident Management Team 3.

Dr. Bill Hartmann
Dr. Bill Hartmann graduated from the University of Minnesota, College of Veterinary Medicine in 1978. After 4 years in private practice, he returned to the University of Minnesota to complete a pathology residency at the Veterinary Diagnostic Laboratory and receive his Master's Degree in Veterinary Anatomic Pathology. Dr. Hartmann took a job with the United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, as a Veterinary Medical Officer in 1985. In 1988, he joined the Minnesota Board of Animal Health as a Senior Veterinarian in charge of ruminant disease programs. Hartmann was appointed Minnesota Board of Animal Health Executive Director and State Veterinarian in 2001.

Jeff Kala
Jeff serves as president of SKW Ranch in Onaway, MI, a purebred,cow/calf, and feedlot operation. He is an active member of the TB Advisory Committee, as well as the northern region implementation subgroup. Jeff is also a standing member of the NorthCountry Beef Producers organization.

Dr. John Kaneene
Dr. Kaneene is a University Distinguished Professor of Epidemiology and Director of the Center for Comparative Epidemiology at Michigan State University. He is a Fellow of both the American Epidemiological Society and the American College of Epidemiology. Dr. Kaneene's research interest is in the fundamentals of the comparative epidemiology of tuberculosis in livestock, wildlife, and human populations. He is particularly interested in designing and evaluating epidemiologically and economically sound TB control and preventive strategies.

Dr. Paul Livingstone
Dr. Livingstone has been involved with researching, managing and controlling bovine tuberculosis (TB) in New Zealand for over 30 years. As the Technical Manager for the Animal Health Board, Paul is responsible for the technical decisions on the tuberculosis control program for cattle and farmed deer, as well as the wild animal control program. He is also a member of the National Science Strategy Committee that makes recommendations on the research strategy for the control of possums and bovine tuberculosis.

Dr. Karla Mesterhazy
Dr. Mesterhazy received her Bachelors Degree (Animal Science) in 2002 and DVM and Masters of Science (Veterinary Microbiology) in 2006 from Iowa State University. She is currently a PhD candidate at Michigan State University (Veterinary Pathology).

Dr. Pauline Nol
Dr. Nol is a scientist and veterinary medical officer with USDA/APHIS, Veterinary Services, Western Regional Office in Fort Collins, Colorado, where she works to develop science-based solutions to disease problems at the wildlife-livestock interface. Much of this research is focused on vaccine strategies against brucellosis and bovine tuberculosis in wild ungulates. Pauline received a B.S. in Zoology from the University of Florida, a D.V.M. from the University of Florida, an M.S. in Veterinary Science at the University of Wisconsin-Madison, and is currently working on a PhD in Epidemiology at Colorado State University.

Mitch Palmer
Dr. Palmer serves as a scientist in the Bovine Tuberculosis Research Group at the USDA's National Animal Disease Center in Ames, IA. Dr. Palmer has been at NADC for 16 years, 12 of which have been dedicated to research on tuberculosis in cattle, deer and other species. Before joining USDA, Dr. Palmer worked as a large animal veterinarian in Lodi, WI. Dr. Palmer received his BS from Utah State University, his DVM from Purdue University and his PhD in veterinary pathology from Iowa State University. Dr. Palmer's research interests include zoonotic diseases and diseases at the interface of domestic animals and wildlife.

Bridget Patrick
Bridget is currently a risk communications specialist with the Michigan Department of Agriculture. She previously served as the Infectious Disease Liaison (2006-2007) and the Bovine Tuberculosis Eradication Project Coordinator with the Michigan Department of Community Health (2002-2006). She received her B.A. in Journalism from Michigan State University.

Dr. David Ramsey
Dr. Ramsey started his research career in Queensland working on the population dynamics of rodents in agricultural systems. After completing his PhD in ecology in 1995 at the Queensland University of Technology he left Australia for New Zealand joining Landcare Research. While there, he worked on the epidemiology of bovine TB in wildlife and developed predictive models to assess the potential of different strategies for eradicating disease. Dave's interests are in population dynamics, epidemiology, modelling and biometrics and in 2007 he moved back to Australia and is currently employed as a biometrician at the Arthur Rylah Environmental Research Institute in Melbourne.

Brent Rudolph
Brent Rudolph is a Research Specialist with the Michigan Department of Natural Resources (MDNR), where he coordinates the Wildlife Division's deer research program. Brent is also a doctoral student at Michigan State University. He has previously served as a regional Habitat Biologist and acting Species and Habitat Management Section Supervisor with MDNR. His professional interests focus on addressing both the biological and sociological challenges to managing wildlife on increasingly human-dominated landscapes.

Dr. Steve Schmitt
Dr. Schmitt has served as the Supervisor of the Wildlife Health Section at the Michigan Department of Natural Resources Wildlife Disease Laboratory for 28 years. He is responsible for overall operation and function of the laboratory, including investigation, monitoring and research of diseases and other factors that affect the health and survival of wildlife in Michigan. The Laboratory is housed at the Diagnostic Center for Population and Animal Health on the south campus of Michigan State University. Dr. Schmitt has been working with bovine tuberculosis in free-ranging deer since 1994, and is regarded as an authority on bovine tuberculosis in wildlife. He has authored over 40 journal articles on various wildlife diseases. He has worked in private veterinary practice in St. Helens, Oregon; with the Illinois Natural History Survey in Urbana, Illinois and with the National Marine Fisheries Service in Auke Bay, Alaska.

Dr. Todd Shury
Dr. Todd Shury, DVM is the Wildlife Health Specialist for Parks Canada in the Dept. of Veterinary Pathology at Western College of Veterinary Medicine. He received his B.Sc. in biology at the University of Lethbridge in Alberta and his DVM at the Western College of Veterinary Medicine in Saskatchewan. Dr. Shury is currently working for Parks Canada as National Wildlife Health Specialist in Saskatoon, Saskatchewan. He previously worked with the Calgary Zoo and Banff National Park in addition to other wildlife agencies in western Canada as a contract wildlife veterinarian.

Dr. Jim Sunstrum
Dr. Sunstrun is the TB Consultant for MDCH. He received his MD from the U of Saskatchewan, Canada, and Residency and fellowship training at Wayne State in Detroit, Michigan. He has a private practice of Infectious Disease in Dearborn, Michigan and is the Medical Director of the Wayne County TB Clinic.

Dr. John Tilden
Dr. Tilden currently is the Director of the bovine TB Eradication Program for the Animal Industry Division, MDA. In that capacity he is responsible for coordination of the overall direction of MDA's bovine TB Eradication program, identification of new approaches to pursue eradication, and obtaining input from stakeholder groups. Tilden has a Doctor of Veterinary Medicine degree from Michigan State University and a Masters of Public Health degree from Johns Hopkins University. He has worked in various capacities for MDA's Food and Dairy Division, the United States Air Force, United States Department of Agriculture, and the Centers for Disease Control and Prevention.

Dr. Scott Wells
Dr. Wells is an Associate Professor in the Department of Veterinary Population Medicine and Education Director for the Center for Animal Health and Food Safety at the University of Minnesota. He received his DVM from Michigan State University. Dr. Wells has been a faculty member at the University of Minnesota since 1999, with research interests related to prevention and control of diseases of cattle, including Mycobacterium paratuberculosis (Johne's disease). He is board certified in the American College of Veterinary Preventive Medicine and is currently a co-Chair of the National Johne's Working Group.

Dr. Melinda Wilkins
Dr. Wilkins is currently the Director of the Division of Communicable Disease, Michigan Department of Community Health. She received her PhD from MSU in 2008, her DVM from MSU in 1994, and her MPH from U of Illinois in 1999. Following veterinary school, she worked for USDA, APHIS, VS, in Illinois. In 1999 she joined the Epidemic Intelligence Service of the CDC. She has been with MDCH since 1999. Her research interests include infectious disease surveillance and zoonotic diseases, specifically *Mycobacterium bovis*.

Tim Wilson
Tim Wilson has been employed as a wildlife biologist with the USDA Wildlife Services program since 2001. One of his duties is assisting producers in Northeast Michigan to reduce their risk of TB infection from potentially infected wildlife. He has a Master of Science degree in wildlife ecology from Mississippi State University and a Bachelor of Science degree in fisheries and wildlife from Michigan State University.

Dr. Michael VanderKlok
Since 1995, Dr. Michael VanderKlok has been active in the Michigan Bovine Tuberculosis Eradication Program as an on-farm testing veterinarian, regional manager, and coordinator for the MDA TB program for livestock in Michigan.

2008 Bovine TB Scientific Meeting

The 2008 Bovine TB Scientific Meeting was held July 23-24 at the Henry Center in East Lansing. The capacity level audience included project partners from MDA, DNR, MDCH, MSU, and USDA. Stakeholder representation included Michigan Cattleman's Association, MI Milk Producers' Association, the MI TB Advisory Committee, Dairy Farmers of America, Michigan United Conservation Clubs, and Michigan Farm Bureau.

The agenda consisted of program and research updates from our project partners (local, state, and federal), in addition to regional updates from Minnesota and Canada. Keynote speakers from New Zealand and Australia provided critical insight into major program dynamics and, during their time in Michigan, also worked closely with MDA and DNR to analyze potential new eradication strategies.

The scientific meeting was sponsored by the U.S. Dept. of Agriculture, and has been summarized in this 2008 Annual Report. For access to specific conference presentations, please go to www.michigan.gov/emergingdiseases and click on the 2008 Bovine TB Scientific Meeting link.

Special Thanks:

2008 Bovine TB Scientific Meeting

Sponsorship
USDA Veterinary Services

Moderators
Dr. Steven Halstead (MDA)
Dr. Dan O'Brien (DNR)
Pete Butchko (USDA WS)

Technical Assistance
Jean Fierke (DNR)
Kristine Brown (DNR)

Planning
Marcia Weld (MDA)
Bridget Patrick (MDA)

2008 Bovine TB Activities Report

Writer
Lana Kaiser (MSU)

Graphic Design
Curtis Remington (MDA)

Editor
Matthew Ankney (MDCH)