

# **Chronic Wasting Disease Research Update**

## **Summary of CWD Quarantined / Control Deer Farm Research Phase 1 thru 6**

With the history of CWD on the landscape in the Cervid farming community nationwide, Phase 1 of this research investigation started on a whitetail deer farm held under quarantine for CWD from the 1st index case in January of 2016. This research effort is to help the farming industry look for answer to this elusive disease process initiation called CWD in cervids. The first and continued hypothesis behind a better understanding of this disease complex origin was designed to answer the following question. Could “Cervids (deer/elk), supported with optimized feed, forage and water through nutrition along with genetic review stave off the debilitating disease onset of CWD in cervids?”

### **Phase 1 Summary**

This review found that the deer farm under quarantine was providing what would be considered a nutrient deficient ration to the deer on this farm by improper mixing of all ingredients to hold together. Though a yearling deer that originally died from a goring incident from another deer, subsequently tested positive for CWD, by IHC method, both in the lymph nodes and brain area.

Upon further rectal biopsy testing, the rest of the deer on this farm have presented no clinical signs of CWD to date. The current ages of the deer on this farm are from 1.5 to 7 years and are expected to convert to CWD positive status given the brain involvement of the CWD prion in the brain of the positive index deer from this farm.

Review of the nutritional and bacterial status of the deer on this quarantined farm and the 2 other CWD negative control farms provides a basis for future follow up of these farms in this study review. In the event that the deer residing on the quarantined deer farm successfully reproduce providing younger animals to include in the study or if current deer start to show clinical symptoms’ of the disease process, a follow up can be initiated with the use of the baseline data collected for comparison.

The endemic area of the state where this quarantined farm is located generally produces 5-6 deer which test positive for CWD in the wild population (within 1-2 miles) yearly. The quarantined farm, being a single fenced facility will provide future opportunities for potential opportunities of nose to nose contact with the wild deer population of this CWD endemic area. Due to the quarantined animals improved body condition, another round of rectal biopsies are planned to update the status of determining an onset of CWD within this small herd.

Other areas of interest resulting from this review include deer farmers paying attention to farm supports for their deer regarding water quality, feedstuffs, animal transfers and sanitation practices by embracing Bio-Security programs under development.

Continued and ongoing review / monitoring of Phase 1 components is warranted as the onset of clinical signs of CWD could take multiple years. A Phase 2 scope will be constructed adding to

the baseline information of work is warranted to ascertain any health status changes (good / bad) to the deer held under CWD quarantine on this farm. There are other farms in Wisconsin that have been determined to have CWD who continue to operate as hunt preserves. These farms could provide critical test materials from the positive side of the CWD disease process. This would provide pertinent information in comparison to current baseline information derived to date. This would speed up future research findings to opportunities in understanding this disease process. To achieve this next step more research funding is needed for the continuance of this study.

## **Phase 2 Summary**

Since the deer were quarantined in early 2016 pre-clinical blood samples were retrieved and tested showing a certain level of gram negative bacteria in their initial assessment. In the sampling of the deer in the spring of 2018 (2 years) after being quarantined for CWD shows that these negative organisms continued to increase to a point where a negative health impact would be generated. Orange 1 and yellow 1 became rectally positive (+) for CWD detection after all deer having their 3 rounds of rectal testing.

By generating new information as compared to past and ongoing developing research by AOS, organism's expression of various physiological systems of the whitetail deer (saliva, rumen, lung, liver, urine, fecal, blood and brain) can now be reviewed for comparative animal health status' of either a positive or negative tilt.

Progress made in the Phase 2 study design for collecting samples for testing continues to show a direct correlation and understanding of where negative bacteria reside in the deer with strong potential to create negative health consequences.

Hay or other forage products produced from fields that use livestock manure or human wastes for land spreading nutrients will accumulate these unwanted negative organisms into the forages that are fed to deer unknowingly and can cause health issues. Knowing where forages are coming from will help in the long run by reducing the sick animal syndrome that many farmers deal with today. The same applies to the water source for the deer. Testing and keeping your water source clean and uncontaminated will go a long way in reducing the negative bacterial load in your deer.

Recommendations from the results of this study so far would be for any forage, feed or water source be tested before providing your deer an unknown potential to hinder their daily health status. Developing a supplier relationship and developing a healthier Bio-Security Plan will ensure not running short on quality feed supplies.

This new information can help the cervid farmer determine vaccine status, parasitic status and provide an overall health profile to support the deer's' overall immune status and disease suppression/control. Some deer that were vaccinated for these organisms still tested positive for bacteria loads such as fusobacterium, clostridia species and other negative bacteria.

A Phase 3 proposal for continuing follow up of the deer on the quarantined and control farms will be generated to ascertain continuing health assessments of the deer during the current disease processes of Orange 1+ and Yellow 1+ or any other deer that might convert to a rectal positive CWD status in this past year of review.

### **Phase 2.5 Summary**

The follow up to the health end points of Orange 1 and Yellow 1 in this report will add to the information we have learned to date. In following these deer biological profile and reviewing their acquisition of multiple negative disease organisms contributes to a disease process leading towards a deer dying with detectable CWD. The disease called CWD is an end life stage disease found typically upon death with an unknown time of indexed exposure to manifest itself to a clinical case.

The process of this review continues to show us through appropriate surveillance testing, that early detection of common negative health-associated environmental organisms is critical to the deer's health and wellbeing. The geographic location of environmental organisms, water or feed could represent an opportunity to exposures to negative associated organisms which could unknowingly start the cascade of diminished health. This would lead to increased risk potential for your deer to manifest towards a more critically oriented disease process over time. Orange 1 and Yellow 1 had these base negative organisms on board (mycoplasma / ecoli shigella) for at least 2 years prior to converting rectal positive upon their 3 rectal exams.

Continuing into Phase 3 will provide more detailed insights into the health of the rest of the deer on this quarantined farm. By continuing the health monitoring of the remaining 4 deer (Does - Pink 1- 96gg, Purple 1- 96gs, Yellow 2- 96gg and Buck Red1- 96gs) in review of their 4th rectal biopsy and continuing medical health surveillance will continue to provide you the farmer insights into building your bio security and BEST management plans on your farm.

Your Bio security plan should include your relationship with your veterinarian for health surveillance and maintenance of your deer. In reviewing your farm practices, you should always error on the side of caution when supplying clean water, feed, hay or control of vermin (crawling/flying) that has the ability to come onto your farm. If you do not follow up on requiring testing of your hay or feeds for nutritional quality for unwanted contamination of high mineral or pathogen contamination puts your deer at unnecessary risks.

### **Phase 3 Summary**

In review of the overall study updates, we started with 3 unknown farm health assessments for deer in an effort to determine what is a normal assessment of the control farm deer as compared to differences to a farmed deer quarantined for CWD.

As we learned, the health status of each deer in the study it became apparent that the farmed deer under quarantine for CWD had a higher negative organism composition than the deer of the 2 control farms. It was also noted that the 2 control farms also differed in their respective health

status though not negatively associated. These health differences identified from the quarantined farm were from sources such as water (e-coli, excess iron), feed (pseudomonas) and hay/forage (ecoli, pseudomonas, excess minerals) products provided or fed to these deer.

It is important when sourcing feeds for nutritional inputs of deer to test and quantify their healthier attributes before providing to deer. This would provide the deer the opportunity to perform to a healthier production status.

By changing all of the feed inputs on the 3 farms as same provided a healthier profile to the deer for the opportunity to measure and follow identified healthier markers in the deer from the improvement of the nutritional inputs as being the same. These improvements showed a reduction in negative associated organisms identified in past deer samples. This change from negative to a more positive associated organism expression should provide support to the deer's immune system. This in turn would minimize the opportunity of negative environmental organisms to create negative conditions in your deer. This could be a key point in your deer health as to not self develop CWD.

Taken collectively, this provides the research the unique opportunities for the continuing health assessment of these remaining deer through this year's pending fawning time points and the pending falls seasonal changes. This provides the availability to also monitor these deer for the past conditions in the disease role in loss of body condition (body fats) or slowness of winter hair coat changes. This information will continue to help the industry in the continuing effort to find answers for the remediation of or elimination of CWD as we know it.

By developing and implementing a sound feeding and biosecurity program for your farm will support your farming activities while minimizing the risk factors we have delineated in this research review to date.

Information provided to date would also be applicable for wildlife agencies or groups in the interests and understanding of disease process' of free ranging wildlife for developing effective best management practices. By understanding areas of opportunities to reduce potentials for the spread for gram negative bacterial organisms or other potential pathogens that wildlife species carry would reduce the potential of any cross over contamination to livestock species such as whitetail deer.

### **Phase 3.5 Summary**

Stress and the subsequent release of stress-related neuro-endocrine hormones adversely affect various aspects of ruminant health including food intake and rumination. Interaction within the animal may account for the deleterious effects of stress on ruminant health. One of those areas concerns the ability of stress to modulate the microbial composition of the ruminant intestinal tract. The elucidation of such neuroendocrine–bacterial interactions in ruminants can lead to new ways to improve various aspects of animal health and production by creating a favorable environment that ultimately will foster a beneficial microbial composition that also retards the persistence of potential food-borne pathogens.

CWD is mostly know to many as the disease process with no known treatment that is deemed infectious and is either just managed as in the wild populations or managed / depopulated in the

case of farmed cervids once detected. Across the globe to the dismay of many deer farmers, hunters and others with aspirations alike, the continued frustration with this CWD testing concept of just finding a prion in a continuum narrative is socially overwhelming by all stakeholders.

In the past 20 year history of CWD research to date, research only looks to develop or refine specific mechanisms of testing to provide either validated testing or early detection methods for the detection of the CWD prion. From various constructs like soil, feed sources, body parts or fluids like urine these testing platforms only seek to find a prion signature in determining a possible positive detection or non detection of a CWD prion in cervids.

The Cervid farm industry and wildlife biologists alike would be better served by testing for bacterial pathogens that creates a negative health consequence in cervids, livestock and other wildlife species alike. With utilization of these testing methods for monitoring or early intervention as used in this study provides for early detection of root causes of disease potential development or progression of pathogenic organisms in whitetail deer leading to deer developing CWD.

This study was designed on a small quarantined deer farm where some control over the studied deer could look at finding what initiates this disease process. In determining the environmental factors that could lead to the starting point of a disease process would then look to review backwards the underpinning of this disease process in a more investigative approach for a root cause.

As the process and environmental aspects of the farm location, feed and water inputs along with monitoring the deer's health, a disease process took the lives of 3 deer over a 4 year period. We learned immensely from data these dead deer provided to some common aspects of a disease process from its starting origin with compelling timeframes of pathogenic organisms to the death of the deer.

In the data presented the study shows the continuance of some common environmental bacterial organisms some pathogenic / some not on the landscape. When these organisms are acquired or reside in wrong places within the deer's body (blood, lungs, brain) they create a negative devastating effect of the deer's immune / hormone system. This degrading condition depletes the health of the deer over time and without early detection or treatment leans towards ending their lives.

The study also set out to investigate the use of new cutting edge testing methods used for monitoring the deer's health profile for pathogenic organisms exposed to the deer. Once identified and understood, then prospective interventions or proper treatments could be put into play in an effort to reduce or eliminate pathogenic organism's negative health consequence.

The presented findings from the death of the 3 deer on the farm helped identifying specific bacterial organisms in wrong locations in the body. This is an important find as to help the

Farmed Cervid industry and wildlife agencies alike to understand what disease organisms were present in these deer from environmental factors exposed to these deer.

In this new understanding will allow the start of developing additional management strategies could lead to the prevention of these bacterial organisms through proper nutrition, supportive health assessment, habitat stability and or early treatment intervention.

In this phase, table 11. shows only 5 bacterial organisms in Yellow 2 that were found in other random control farmed deer tested. Staphylococcus and Shigella- ecoli were found in various locations in Yellow 2 and other deer used as controls from multiple farms. Though organisms were found in control deer blood none of these organisms were found in any control deer fecal. This comparison of negative organisms from a deer dying with a life ending disease called CWD shows that there are some underlying health concerns detected in an early state of a disease onset that if left unattended could diminish a deer's' health and wellbeing leading to self developing CWD.

Table 11 also showed some bacterial organisms found in Yellow 2 were also found in other random farm deer of both sexes in random deer samples from around the state. Early detection is important for maintaining health promotion in deer.

By developing a monitoring program for these or other pathogenic organisms in deer or the deer's environment (water, feed, habitat, other) will provide an extra layer of bio - security so these organisms don't create a negative stressful condition over time in deer. Continued negative stress from multiple environmental factors will end up compromising the immune system of deer at risk creating a negative health consequence.

This in turn reduces the deer's capability to stave off the onslaught of bacteria overload including invasion of the brain centers by bacterial toxic elements disrupting the body's hormone control systems. This leads to the cascading events of further bodily dysfunction including muscle and fat deterioration of the deer's body as a wasting condition.

This bacteria overload in livestock including deer is termed bacteremia. If not monitored for or detected early for proper treatment interventions will in time lead to the deer's death. Continued follow up will be conducted on these deer as we enter year 5 of this study post exposure of these deer to the 1st CWD death on this farm in January 2016.

#### **Phase 4 Summary**

In review of the overall study this year, samples collected and submitted in April 2020 were delayed for processing due to Covid-19 redirection of testing resources in multiple Academic Institutions for this human associated pandemic concern.

This spring, we continued the assessment of our quarantine farm (adding elk) along with deer from 2 control farms in different geographical areas in non-CWD areas of the state of Wisconsin. This assessment is to determine what is normally physiologically-associated with control farm

deer health organisms as compared to differences found in the quarantined farmed deer / elk in this study conditions for CWD.

We do have to proceed with remembering that deer / elk on the quarantine farm have had prior exposure to negative bacteria diminishing their respective immune function. The deer have also been exposed multiple times to other deer deceased with CWD being detected upon death. Move forward, past our original 5th year of initial CWD exposure (Jan.2021), we hope to show benefits of these health improvements to diminish deer / elk opportunities for self developing CWD.

Deer on control and quarantine farms continue to show positive values of bacterial likeness being fed the same feed pellet. More importantly, it starts to show true differences between each farm deer / elk associated with their respective farm water and other forage sources fed deer / elk and start to show core bacterial organisms not associated with water / feed in deer / elk.

For the first time of this study we found the bacteria *Acinetobacter* being detected in water sources though at a low level. This level was noted to be found highest in the deer but not elk fecal material and to a lesser extent in their respective saliva samples. This organism is of concern because of associated antibiotic resistance if it gains a foothold in deer / elk. This organism could be eliminated from the deer / elk water source by proper water sanitation practices used for potable water.

One good change found on the quarantine farm this year was the reduction / elimination of undesirable organisms like *Escherichia – Shigella* and *mycoplasma* from the deer's' blood. *Aeromonas* and *Myroides* bacteria were also found to be present in past water testing and deer samples on the quarantine farm that were also absent in this year's assessments. The absence of these negative health-associated organisms in quarantine deer is a welcome finding.

Past samplings of blood from the quarantine farm, that contained these negative associated bacteria, were associated with deceased deer later determined positive with CWD. Overall, quarantine deer / elk continue to show higher levels of bacterial enrichments than control farms overall.

It is unknown the geographical distribution of negative associated bacterial organisms in the environment. Keeping them off of your farm is the biggest challenge farming faces in today's production cycles given they arrive to your farm be it winds, rain, bird, vermin or predator.

What we can control is untreated water since this can be a tremendous source of negative associated bacterial in deer / elk. Be it water from a pond, creek, river or lake it is still an untreated source of drinking water. Here in Wisconsin, as well as in other states, surface water sources or shallow wells (sand points) are of concern since water supply systems from private wells are un-regulated in part.

When a water source is not treated in some manner it would be considered a non-potable water source. By not maintaining potable water (clean/fresh) sources for deer / elk exposes them unnecessarily to risks that could lead to an undesirable outcome in farm production.

Deeper drilled water wells are regulated but still have a need for monitoring and routine bacterial sanitation maintenance. This is why in larger towns and cities treat water sources for human consumption, in some manner, to mitigate negative associated bacteria and health concerns. Farmers should view this information and take appropriate action for their own livestock/cervid support of improved production status.

Some other reference materials in this phase report are recommendations for reducing the potential spread of Chronic Wasting Disease and would be worth building or adding to your farm bio-security plan. It is noted that any artificial water structures are one of the most common vehicles for environmentally transmitted diseases. Although prion molecules are hydrophobic, and cannot exist freely in water, they exist bound to particulate and organic matter in aquatic environments. Organic matter in water troughs allows for increased prion accumulation if present and the potential for prolonged infectivity as compared to clean water sources.

Artificial water structures, such as water troughs and guzzlers, placed on the landscape, whether for agricultural purposes or specifically for wild animals, are accessed by deer. These water structures can repeatedly attract deer at concentrated sites, allowing for increased contact between animals and the potential for disease organism transmission between wildlife / wild deer and domestic livestock.

Increased prion accumulation in water containing organic particulates, and increased contact rates associated with artificial water structures on the landscape pose the potential risk of CWD development / transmission among wild cervid populations.

Some general recommendation / practices to reduce potential disease transmission at artificial water structures:

- a. Place water structure in locations undesirable or inaccessible to wild deer
- b. Keep water clean of organic matter and particulates
- c. Replace water frequently
- d. Frequently clean water structure with a 50:50 bleach water solution
- e. Avoid the use of stainless steel and porous materials for construction of water containment structures
- f. Do not intentionally place water structure on the landscape for wild deer or other wildlife.

As we continue to learn the bacterial status and their respective differences on each farm in the study it's apparent that the farmed deer under quarantine for CWD still had a higher negative organism composition than the deer of the control farms.

An increased and sustained level of a negative associated bacteria load is what diminishes a deer's immunity status. Continued negative associated bacteria load in deer / elk could also have a negative health impact of reproduction, survivability and or products to market.

Besides water sources it is important when sourcing feeds including supplements' or trace minerals for nutritional inputs of deer/ elk to ensure these items are tested to quantify their



appropriateness before providing to deer/elk. This review of dietary inputs would also provide the deer the opportunity to perform to a healthier production status.

By reviewing 3 different rations on 3 different farms in the beginning we decided to change the base feed inputs on the 3 farms to the same pellet ration. This test ration being fed on all 3 farms has currently provided for a healthier profile to deer/elk providing more consistent results across each farm in this study. Unfortunately this is not the case on all farms in our industry. By providing the same feed on each of these farms provides for the opportunity to measure and follow identified healthier markers in deer on control farms from the improvement of the nutritional inputs to the deer/elk on this quarantined farm.

These improvements to date have shown a reduction in negative associated organisms identified in past deer samples allowing for refinement in this research review. This change from negative to a more positive associated organism expression should provide support to the deer's immune system to perform at more normal rate. This in turn would minimize the opportunity of negative environmental organisms to create negative conditions in your deer / elk.

In mammalian species it is noted that aging is considered the main risk factor for several neurodegenerative diseases and is accompanied by chronic altered inflammation involving changes in microglia (brain) morphology, phenotype and activity. By developing and implementing a sound feeding and bio-security program for your farm will support your core farming activities (fawn / calf production) for the products of future farm sales.

While noting and minimizing the risk factors for developing chronic inflammation we have delineated in this research review to date provides a path forward to achieve positive farm production goals.

#### **Phase 4.5 Summary**

In our current farm review we identified water born bacterial organisms that were being supplied in the deer's drinking water. In the past water testing's on the quarantined farm went undetected. This was due to the one time a year of quantifying test samples vs. seasonal sample collections of disease associated organisms from changing ground water matrix's'. The increased bacterial load supplied via water for the deer's drinking water in the fall/winter season was more enriched than in the spring time water supply. There were other bacterial organisms found to be enriched in the deer that were not associated with the deer's water supply as noted by the control deer used in this study from different geographical areas of the state.

These new bacterial organisms of concern found in the tissues of a deceased whitetail deer were directly associated with the farm's water supply. In reviewing of the past research relating to this quarantined farm, our current findings have now identified certain bacterial organisms and their capabilities to diminish deer / elk health. These bacteria identified have the capabilities and pathways to also generate pore forming toxins. These bacteria use their toxins to hijack a cell's physiology and in this process they create B-barrel structures that when inserted into the cells lipid membranes create B- sheet structures in similarity if not identically the same as a conformational protein change in what we only know about prion creation to date in deer/elk.

Future, by the farm management first identifying, then reducing or eliminating these identified bacterial sources from the farm chain of supplies would provide for a higher level of bio-security. This improved surveillance and actions taken is needed to reduce the bacterial burden loads in deer / elk. Other bio-security health measures should include the consideration of where products brought to the farm including other transferred deer / elk from other geographical locations. By continually developing your farms best management practice through the use of an effective vaccine program should provide for a risk reduction in the exposure to these identified bacteria with capabilities to produce pore forming toxins leading to a misfolded prion structure.

This new information provides the farmer tools for the continuing health management of their deer / elk from potentially developing B-sheet structures from these bacterial toxins that are found to be consistent with that of the hallmark signature of the prion B-sheet structure in the disease development in deer we have come to only know as CWD.

### **Phase 5 Summary**

In previous research reports we have continued to advance new knowledge to better understand this disease process in deer/elk called CWD. We have currently passed the 5 year mark of CWD exposure to deer / elk, from the first index case on this farm, in research with live animals under CWD quarantine conditions.

In this time, the oldest buck has bred 5 different Does, now deceased and confirmed CWD positive. We are currently left with 3 whitetail bucks (6.5 years, 2.5 years and 1 year), and 1 bull elk (12 years) at 5 ½ years post CWD exposure on this farm. These animals will continue to provide important future pathways forward in the continuing understanding in the investigation into the root causes of CWD and mitigation efforts to date for the farm cervid industry.

### **Phase 6 Summary**

In this review, limited historical research showed bacteria were thought not to be the root causal pathway to the onset of CWD in cervids. More recent data demonstrates otherwise.

Again, negative bacteria was found in deer on a CWD quarantined farm, and the wild deer population of the endemic CWD area of SW Wisconsin. These negative bacteria were not present on control farms or wild deer in this study outside of the SW Wisconsin endemic area. These bacteria, as outlined, have a direct capacity to reduce the proper immune function of cervids and, in time, allows for cervids to self develop CWD.

We continue to support efforts of the cervid farm industry to build upon farm management practices. The farmer needs to be continually vigilant in monitoring for, reduction of, and elimination of negative bacterial sources that would have a negative impact to your cervids.

Left unchecked in practice, negative bacteria will lead to immunity challenges of cervids. These challenges would result in cervids developing either an acute or chronic health consequence, which negatively impacts cervid health and the farms bottom line, a healthy herd.

Using these pro-active practices would provide an elevated level of continued Bio-Security. Improving surveillance techniques leads to identifying corrective actions needed to be effective in the reduction of negative bacterial loads in cervids when warranted. One important area often overlooked is the surveillance of feed, forages and water sources offered to cervids on the farm. Part of developing your farms best management practice includes effective health care program including vaccines, parasite control. Health care support includes timely preventative care for all cervids including those prior to birth of fawns or calves on the farm. By reducing the potential risks of exposing your deer and elk to bacteria with infectious capabilities of pore forming toxins minimizes a negative health consequence to your herd. This information provides the cervid farmer and wildlife specialists alike new tools for improving the health management of their herds.

This herd health improvement process has resulted from our supported research. It continues to provide new pathways toward practices, that when used appropriately, will result in positive mitigation against a disease. On the farm or in the wild cervid populations alike these processes will help protect against the herd's development of CWD.

### **Quarantined Research Farm Update as of 10-20-2023**



**Left - Purple 2 (GS – GEBV +0.0445) turned 4 years of age August 15, 2023 while sibling  
Right - Purple 3 (GS – GEBV +0.013) turned 3 years of age on July 1 2023.**

Both Purple 2 and Purple 3 were born from Purple 1 (8 year old doe, GS – GEBV?) and Red 1 (7 year old buck, GS - GEBV +0.0637) after changes were made on farm via feed and water supply.

Both breeder deer (original feed/water) of these two bucks had developed CWD from environmental organisms identified on farm as causal agents of prion disease formation and are now both deceased.

Purple 2 and 3 were fetal programmed on new feed and clean water supply on farm. All whitetail deer in this study were born on farm either before or after farm first put under quarantine in 2016. Bull elk was acquired on this farm prior to the first CWD detection in a whitetail deer.

How long deer / elk are exposed to negative health associated bacterial organisms will determine how long it could take to turn around their health status.

If farmed deer / elk health status is left unchecked or without some form of intervention is considered the biggest risk factor facing the farmer today for deer/elk developing CWD as noted in these research findings.



**On the same farm, a bull elk (age 14) in a different pen was also switched to the same feed and water supply as the whitetail deer has not shown any sign of illness since the farm was put under quarantine in 2016.**

The compilation of this research effort provides a small snapshot into the research effort to date in the investigation of where or how CWD develops in cervids such as deer or elk. This summary report provides the farmer/producer and wildlife professionals new tools not available before in a new look at a physiological disease process that was thought not to be bacterial oriented or just spontaneous in nature. Report data and discussion is supported in the full phase reports supported by peer reviewed references as cited.

Submitted by: Jerome Donohoe, AOS

Full reports can be reviewed by contacting your organizational Foundation Board members from the following organizations that have either provided research funding in whole or in part.

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