Rodenbaugh, Cassandra I., et al. "Dynamic viscoelastic coagulometry of blood obtained from healthy chickens." *American journal of veterinary research* 80.5 (2019): 441-448.

Abstract:

OBJECTIVE: To assess feasibility of the use of a **dynamic viscoelastic coagulometer on chicken blood and compare coagulation variables for fresh whole blood and sodium citrate-preserved whole blood as well as effects of 3 coagulation activators on blood from chickens**.

SAMPLE: Blood samples from **30 hens**.

PROCEDURES: Chickens were allowed to rest undisturbed for 1 hour. A blood sample was collected from an ulnar vein; 1.4 mL was analyzed immediately, and 1.8 mL was mixed with sodium citrate and subsequently recalcified and analyzed. A separate coagulation activator (glass beads, kaolin clay, or tissue factor) was in each of the 2 channels of the analyzer. Chickens were allowed a 1-hour rest period, and another blood sample was collected from the contralateral ulnar vein; it was processed in the same manner as for the first sample, except both channels of the analyzer contained the same coagulation activator.

RESULTS: **Compared with fresh samples, citrated samples had higher values for activated clotting time and platelet function and lower clotting rates**. **Intra-assay coefficients of variation of coagulation profiles for citrated samples were markedly greater than the limit of 10%,** whereas values for fresh samples were close to or < 10%. CONCLUSIONS AND CLINICAL RELEVANCE: Results suggested that **use of a dynamic viscoelastic coagulometer on chicken blood was feasible and that analysis of fresh whole blood from healthy chickens provided results with less variability than did analysis of citrated blood**. Samples **preserved with sodium citrate were associated with significant relative hypocoagulability, compared with results for fresh blood**.

Key Points:

* Avian thrombocytes – adhere to vascular defect and form a monolayer
* Mammalian platelets – adhere and form a 3D aggregate
* Extended clotting time in birds thought to be associated with **lack of intrinsic pathway (factors XI and XII)**
* Dynamic visceroelastic coagulation (DVC) – measures resistance to oscillation of the probe as clot forms then lyses
* Significant differences between all activators (TF, kaolin, glass) for ACT
* Significant difference for clotting rate for TF and glass
* Significant difference for platelet function for glass
  + Platelet function not reported when kaolin used
* Citrated blood significantly longer ACT, lower clotting rate, lower platelet function
* A large number of chickens were lipemic – this has been known to interfere with visceroelastic coag tests in mammals; but considered normal in the chicken due to repro state so included in data set
* Significant negative correlation between platelet function in whole blood and observed thrombocyte numbers

Take home: Using fresh whole blood resulted in lower variability in DVC results; sodium citrate samples were relatively hypocoagulable

Knafo, Sophie Emmanuelle, Jennifer E. Graham, and Bruce A. Barton. "Intravenous and intraosseous regional limb perfusion of ceftiofur sodium in an avian model." *American journal of veterinary research* 80.6 (2019): 539-546.

OBJECTIVE To assess whether IV regional limb perfusion (IVRLP) and intraosseous regional limb perfusion (IORLP) of ceftiofur sodium resulted in clinically relevant drug concentrations in the synovial fluid of the tibiotarsal-tarsometatarsal joint of chickens (ie, an avian model) and to determine whether one of those techniques was superior to the other.

ANIMALS 12 healthy adult hens.

PROCEDURES Birds were randomly assigned to receive ceftiofur sodium (2 mg/kg) by the IVRLP (n = 4), IORLP (4), or IM (control; 4) route once daily for 6 consecutive days. Blood and tibiotarsal-tarsometatarsal synovial fluid samples were collected 15 minutes after ceftiofur administration on predetermined days for quantification of ceftiofur concentration. Plasma and synovial fluid ceftiofur concentrations were compared among the 3 groups.

RESULTS All 4 birds in the IVRLP group developed mild to moderate bruising around the injection site, but this bruising did not prohibit completion of the prescribed treatment regimen. No adverse effects were observed in any of the other birds. The mean plasma and synovial fluid ceftiofur concentrations exceeded the therapeutic threshold for most common bacterial pathogens (> 1.0 µg/mL) at all sample acquisition times for all 3 groups. The mean synovial fluid ceftiofur concentration for the IVRLP group was significantly greater than that for the IORLP and control groups at all sample acquisition times.

CONCLUSIONS AND CLINICAL RELEVANCE Results suggested that IVRLP may be a safe and effective technique for antimicrobial administration to birds with joint infections, contaminated wounds, pododermatitis, and other musculoskeletal infections of the distal aspect of a limb.

Introduction:

* IVRLP = IV regional limb perfusion; IORLP = intraosseous regional limb perfusion
* Currently, RLP not validated for use in avian species
* Any soft tissue infection in the distal aspect of avian distal limb has the potential to spread into the bone because of limited soft tissue covering the bones- amputation not always an option, especially for wild birds

Study/results:

* All birds anesthetized for ceftiofur administration/sample collection
* IVRLP procedure:
  + Penrose drain used as a tourniquet around the selected leg at mid tibiotarsal level
  + 25g catheter put into the metatarsal vein → dose of ceftiofur diluted with sterile saline (0.9% NaCl) solution total volume of 3 mL, which was then injected through the catheter followed by 0.3 mL (the volume of the butterfly catheter) of sterile saline
  + IVC removed, bandage placed and tourniquet left on for 10 minutes
* IORLP procedure:
  + Lidocaine injected into the periosteum of the proximal tibiotarsal bone
  + Penrose drain was used as a tourniquet around the mid femoral level
  + IO catheter placed (Sterile 22-gauge, 1.5-inch spinal needle) into the proximal aspect of the tibiotarsal bone
  + (indwelling- so secured with tissue glue and tape tabs that were sutured to the skin)
  + Dose of ceftiofur was diluted with sterile saline solution for a volume of 3 mL, which was injected through the catheter followed by 0.3 mL of heparinized saline solution to ensure that the entire dose was administered and to keep the catheter patent
  + Tourniquet was left in place for 10 minutes to allow the drug to perfuse into the tissues distal to it
  + Tourniquet was removed, and the leg wrapped with a bandage to protect the indwelling IO catheter which was left for 6 days during the entire tx period
* Results- only adverse effects were bruising from the IVRLP, none from the IORLP or IM treatment groups
  + IVRLP resulted in a significantly greater concentration of ceftiofur in the synovial fluid of the ipsilateral tibiotarsal-tarsometatarsal joint of chickens than either IORLP or IM administration of the same dosage of the drug
  + Following IVRLP, the synovial fluid ceftiofur concentration was several times that in plasma
  + Results of the present study indicated that ceftiofur concentrations believed to be therapeutic against most bacterial pathogens could be achieved in synovial fluid samples obtained from the tibiotarsal-tarsometatarsal joint of chickens following IVRLP and IORLP of ceftiofur (2.2 mg/kg) once daily for 6 consecutive days

Takeaway: IVRLP may be a safe and effective technique for antimicrobial administration to birds with joint infections, contaminated wounds, pododermatitis, and other musculoskeletal infections of the distal aspect of a limb.

Complete Blood Cell Count and White Blood Cell Counting Method Comparison in 49-day-old Bobwhite Quail (Colinus virginianus).

Kanda, I., Robertson, J., Meinkoth, J. and Brandão, J.

*Journal of Avian Medicine and Surgery*, 2020;34(2):132-141.

The northern bobwhite quail (Colinus virginianus) is a game bird experiencing decline throughout much of its range. There are limited species-specific and age-specific hematologic data for bobwhite quail. **Complete blood cell counts in eighteen 49-day-old captive-raised quail of unverified sex were used to contribute data to reference intervals for the species as juvenile animals**. Values for packed cell volumes, total solids, red and white blood cell counts, and white cell differential calculations were recorded for each animal. Bobwhite quail of this age were found to be primarily lymphocytic, but considerable variability was observed. White blood cell counts were obtained by estimates from blood smears and Phloxine B stain. White blood cell counts performed with ×1000 magnification did not compare well with other white blood cell methods, including Phloxine B stain.

**Background**

* Northern bobwhite quail - near threatened IUCN
  + Heterophilic leukogram at 15hr post-hatch, become lymphocytic at 2 wk, then heterophilic at sexual maturation
  + Females significant increase in heterophils:lymphocytes during onset of egg production
* WBC
  + Diff (x1000): 500 leukocytes counted/categorized / 500 x 100 = %
  + Indirect count, Phloxine B stain 1:32 dilution, Neubauer-ruled hemocytometer
    - Stained cells in both chambers / 1000 = cells x 109/L
  + Count (x400): count leukocytes in 10 monolayer fields / 10 = avg/hpf x 2000 / 1000 = cells9/L
  + Count (x1000, oil immersion): count in 20 monolayer fields / 4 = avg/5 oil immersion fields / 1000 x 3500000 / 1000 = cells9/L
  + Total WBC/uL = (Total het + eos x 1.1 x 16 x 100)/(%het + % eos)
* RBC count: Natt-Herrick’s solution/stain diluted to 1:200, Neubauer hemocytometer
  + Count 4 corners and 1 central square of central large chamber x 10,000 = total RBC x 1012/L
* MCV: PCV (%) / RBC (x1012/L) x 10

**Key Points**

* EDTA blood
* Primarily lymphocytic, Het:Lymph ratio highly variable
  + May have been transitioning from lymphocytic when young to heterophilic when mature, this occurs at different rates according to sex in bobwhite quail
* WBC count at x1000 had fair correlation with indirect but were sometimes higher
  + X1000 was consistently below count on x400
* WBC count at x400 had little, if any, correlation with indirect method and was usually higher

**Conclusions**

* Young bobwhite quail have primarily lymphocytic leukogram similar to other Galliformes species
* Estimating total WBC count on x1000 gave lower count than indirect Phloxine B method or at x400 but had fair correlation with indirect
* Estimating total WBC count on x400 was higher than indirect with little to no correlation

What is your diagnosis - chicken Marek’s

Steven M. Bessauer Almeida, BS; Heather R. Shive, DVM, PhD; Janice B. Harvey, DVM; Luke B. Borst, DVM; and Eli B. Cohen, DVM

JAVMA 2018;252(2):173-175

**Key points**

* 3 yo domestic hen, acute non-weight-bearing lameness/paresis left pelvic limb, weak withdrawal, questionable deep pain, severe muscle atrophy
* Left renal mass on digital cloacal palpation, radiographs, ultrasound with sciatic nerve compression/entrapment and neurogenic muscle atrophy
* Histo: lymphosarcoma (sheets of round cells with scant eosinophilic cytoplasm and round nuclei, > 30 mitotic figures/hpf), similar cells found in right kidney and lung
  + CD3+ (T-cell) on IHC
  + Mature small lymphocytes in left sciatic nerve (neuritis)
  + Pulmonary pneumoconiosis (interstitial fibrosis from inhaling dust)
* Diagnosis: Marek disease secondary to gallid herpesvirus-2 with neuritis of peripheral C fibers

**Review**

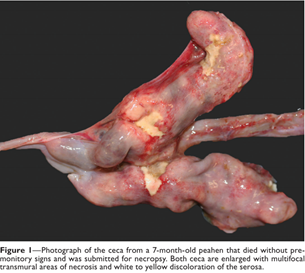
* Renal carcinoma: most common avian renal neoplasm
* Ddx for pelvic limb paresis in avian species: trauma, heavy metal toxicosis, gonadal neoplasma (ovarian adenocarcinoma, granulosa-theca cell tumors)
* Marek disease: herpesvirus, commonly associated with lymphoproliferative neoplasms in chickens
  + Transmission: direct, indirect, airborne routes
  + Secondary lymphoproliferation in iris, skin, visceral organs
  + No treatment
  + Vaccination available

Pathology in Practice - Peafowl Histomonas

Erin Adams, DVM; Marcia R. S. Ilha, DVM, MSc

JAVMA 2018;252(10):1227-1230

**Key points**

* 7 mo female peahen died with no premonitory signs
  + Free-ranging on property with a pond visited by other wild fowl and with neighboring turkeys
  + 10/11 peafowl on the property had died
* Gross: severe emaciation, right pectoral area of necrosis, yellow foci throughout liver parenchyma, cecal necrosis with yellow, caseous debris and ulcerated, red mucosa.
* Histo/Morph: bilateral marked diffuse necrotizing ulcerative transmural typhlitis and mild, multifocal necrotizing cholangiohepatitis with intralesional protozoa consistent with *Histomonas meleagridis*
* Cause of right pectoral necrosis was unknown - ddx nutritional myopathy (Vit E/selenium deficiency), toxic myopathy, exertional/capture myopathy, IM injection

**Review**

* ‘Blackhead disease’ - birds develop methemoglobinemia causing cyanosis and gray/blue skin color on the head, drowsiness, sulfur-colored feces, fever
* Gross: distended ceca filled with caseous necrotic debris and variably sized necrotic liver lesions can be craterous or tumor-like
* Histo: seen on H&E or periodic acid-Schiff, eosinophilic 5-20 um diameter flagellated trophozoites with basophilic central nucleus
* Infects Galliformes (chicken, quail, pheasant, turkeys, grouse) \*peafowls related to turkeys
* Transmission: oral/cloacal exposure - replicates in ceca, invades portal venous system to liver
  + Hepatic necrosis, overexuberant immune response, death
  + Replicated histomonads shed in the feces
  + Experimental transmission more successful when vectored by intermediate host
  + Some *H meleagridis* strains produce cyst-like stages that may survive outside host
  + ‘Cloacal drinking’ of fecal contamination may contribute to lateral transfer (rate or 33%)
    - Viable 6hr on straw, feathers, feed, 9hr in nonchlorinated tap water/feces
* Complex life cycle, several intermediate hosts - primarily *Heterakis gallinarum* ‘cecal worm’
  + *H gallinarum* harbored in earthworms, houseflies, grasshoppers, sow bugs
  + *Heterakis* eggs persis in soil up to 3 yrs, remain positive for histomonads up to 150 wk
* Turkeys: cecal lesions by 3d, extensive cecal lesions and histomonads visible in affected tissues 5d post-infection, liver lesions by 6-8d, deaths peak 13-15d (delayed when transmitted in *Heterakis*)
* Chickens: may be carriers of *Heterakis*, earlier and stronger immune response to *Histomonas* reducing signs of infection and movement to the liver (upregulate cytokines within first 5d)
* Wild ducks - may be carrier species (no clinical signs)
* Also found on PCR of liver in chukars and bobwhite quail (chukars also had cecal worms)
* Controlled with antiflagellate feed additives and treatment - banned in food species in EU in 2000’s resulted in resurgence

[Anna Schmitz](https://bioone.org/search?author=Anna_Schmitz), [Franz Kronthaler](https://bioone.org/search?author=Franz_Kronthaler), [Katrin Stein](https://bioone.org/search?author=Katrin_Stein), [Monika Rinder](https://bioone.org/search?author=Monika_Rinder), and [Rüdiger Korbel](https://bioone.org/search?author=R%C3%BCdiger_Korbel) "DECLINE OF GAME BIRDS (*PHASIANUS COLCHICUS* AND *PERDIX PERDIX*) IN BAVARIA: A SURVEY ON PATHOGENIC BACTERIA, PARASITES, PESTICIDE RESIDUES, AND INFLUENCE OF SET-ASIDE LAND AND MAIZE CULTIVATION," Journal of Zoo and Wildlife Medicine 48(1), 18-30, (1 March 2017). <https://doi.org/10.1638/2014-0126.1>

Abstract: Due to a Europe-wide decline of grey partridge (*Perdix perdix*) and pheasant (*Phasianus colchicus*) populations, this study was conducted focusing on the county of Bavaria, south Germany. The aim was to assess the health status of game birds and identify possible causes of decline. For this purpose 203 pheasants and 11 partridges were examined during the 2011 hunting season. Pathologic examinations were conducted including examinations for parasites and bacteria. Due to public health significance, a screening for *Salmonella* sp., as well as real-time polymerase chain reaction examinations for *Campylobacter* sp. and *Mycobacterium avium* ssp. *avium*, were done. Because pesticides and land-usage can possibly influence bird numbers, the birds were screened for environmental toxin residues, including neonicotinoid insecticides, and land-usage data were correlated with the hunting bags. The result was a very-strong positive correlation of set-aside areas and a less-strong negative correlation of maize cultivation acreage. More than 90% of the birds had a good health status; only individuals showed pathologic alterations. For example, avian tuberculosis was found in two pheasants and a severe capillariosis in two partridges. A possible role of female reproductive disorders has to be confirmed in further investigations. In conclusion, results suggest the decrease of set-aside areas could be a possible reason for decline.

* Introduction:
  + Possible reasons for population fluctuations and decline in game birds include loss of habitat and food sources, pesticide usage, changes in temp and precipitation (esp during breeding season) and predation.
  + This study looks at health status of game birds to see if any diseases or toxins could be linked to game bird decline. Changes in agricultural land use with regard to acreage of maize fields and size of set-asides correlated with pheasant hunting bags.
* M+M:
  + 203 adult pheasants, 11 adult partridges from Bavaria in southern Germany, Oct 2011-May 2012.
  + Carcasses examined following hunt for necropsy.
  + Parasitologic examinations performed via direct fecal smears and PCR for Histomonas meleagridis if liver necrosis on necropsy.
  + Bacteriologic examination of liver, heart, lungs.
  + Histology of gross lesions.
  + PCR for adenovirus and virus cultivation if suspicion.
  + Tox analysis on liver.
  + Land-usage evaluation – correlated hunting bags with land-usage data.
* Results:
  + An infectious agent only found in one bird – Mycobacterium avium avium/silvaticum.
  + Some pheasants had tracheitis or bronchitis.
  + Parasites – heterakis, capillaria, eimeria, teichostongylus, syngamus.
  + E. coli most commonly cultured from liver, heart, lung. Considered normal contaminant.
  + No Campylobacter was detected.
  + Lead and promecarb toxicosis cause of death in two pheasants.
  + Significant positive correlation between the hunting bags and the amount of set-aside area was found.
  + A significant negative correlation between the Bavarian hunting bags and the area cultivated with maize.
* Discussion:
  + Significant effect of land usage on pheasants and partridges in Bavaria.
    - Reduction in set-aside and less-distinct areas, and an increase in maize cultivation areas coincided with decline of game bird numbers.
  + Heterakis most commonly detected parasite.
  + Partridges appear to be especially susceptible to capillariosis.
  + Only one bird with parasites showed clinical signs, so they concluded parasites have not directly contributed to decline in pheasant numbers in Bavaria.
  + Concluded that the health risk for human consumption of Bavarian game birds is low (no Salmonella or Campylobacter was found).
  + Environmental toxins do not appear to be contributing to decline of game birds in Bavaria.

Journal of Zoo and Wildlife Medicine 49(3): 671–679, 2018

**REVIEW OF MORTALITY AND EFFECTIVENESS OF NEONATAL TREATMENT IN CAPTIVE ATTWATER’S PRAIRIE CHICKENS (*TYMPANUCHUS CUPIDO ATTWATERI*)**

Lauren Mulreany, B.S., Joseph Flanagan, D.V.M., Christine Molter, D.V.M., Dipl. A.C.Z.M., Lauren Howard, D.V.M., Dipl. A.C.Z.M., Maryanne Tocidlowski, D.V.M., Dipl. A.C.Z.M., Stephen Werre, Ph.D., Stanley Vanhooser, D.V.M., M.S., and Michael Morrow, Ph.D.

**Abstract:** A retrospective study of mortality and neonatal treatment for 975 Attwater’s prairie chickens (*Tympanuchus cupido attwateri*) was conducted from 2009–2015. Gross necropsy, histopathology, and medical records for chicks less than 8 wk of age at the Houston Zoo were reviewed and summarized. The total mortality rate was 36% (n 1 = 352). **Yolk sac infection was the most common cause of death (21%; n = 73) followed by maladaptation (19%; n = 68), musculoskeletal abnormalities (19%; n = 66), necrotic enteritis (13%; n = 44), and mucoid enteritis (11%; n = 39).** Gavage feeding of a highly digestible formula was associated with a higher proportion of necrotic enteritis and a reduced occurrence of both mucoid enteritis and maladaptation. Meloxicam administration had a significantly reduced incidence of mucoid enteritis. Survival past 10 days of age, prevention of neonatal bacterial infection, and supportive treatment with meloxicam are important factors to increase chick survival and improve captive breeding success for Attwater’s prairie chickens. Gavage feeding of a diet low in digestible carbohydrates has the potential for reducing disease due to necrotic enteritis in this species.

**Key Points:**

* Yolk sac infections most commonly caused by Escherichia coli – exposure of chick naval, less commonly contamination of egg shell or vertical transmission (reproductive infection)
* Incubator settings – 37.5 C, 55-65% humidity
* Orthopedic disorders – perosis (chondrodystrophy) due to nutrient deficiencies, splay leg (spraddle leg) associated with slick floors or high humidity in incubators
* Mucoid enteropathy etiology unknown
* Necrotic enteropathy likely due to Clostridium perfringens, shedding increased with diets high in easily digestible cereal grains

**Take Home:** Diets low in fermentable carbohydrates reduce risk of necrotic enteritis, egg & incubator sanitation reduces risk of yolk sac infection

Kelly, E. J., Baldwin, T. J., Frame, D. D., Childress, A. L., & Wellehan, J. F. (2018). Haemoproteus (Parahaemoproteus) spp. in captive-bred bobwhite quail (Colinus virginianus) in southern Utah, USA. *Journal of wildlife diseases*, *54*(4), 726-733.

Abstract: A captive-bred Bobwhite Quail (*Colinus virginianus*) ranch in southern Utah, US experienced high mortality rates in the late summer and fall of 2012. Nine juvenile birds were necropsied at the Utah Veterinary Diagnostic Laboratory. Gross lesions included pale skeletal muscle with **multifocal hemorrhages and petechiae in the air sacs and serosal surfaces of most organs.** Histologically there was moderate to severe, **multifocal, degenerative myositis with intramyofiber schizonts and minimal lymphoplasmacytic infiltrates in the proventriculus, ventriculus, heart, and skeletal muscle. There was also moderate fibrinoid to heterophilic vasculitis in multiple organs with vascular intraendothelial or intravascular merozoites and scattered thrombosis. In the liver and spleen there were multiple degenerative schizonts** that had ruptured. Blood smears from three of the birds were stained with Wright-Giemsa stain and examined at a referral laboratory. Although the blood cells were deteriorated (postmortem artifact), life stages (exact stages not specified) consistent with *Haemoproteus* spp. were identified in erythrocytes. Polymerase chain reaction done on pooled tissues from two birds produced an amplicon in both pooled samples, and direct sequencing confirmed the presence of 533 base pairs of a *Haemoproteus* sp. in the subgenus *Parahaemoproteus*. **The identification of *Parahaemoproteus* spp. in quail in southern Utah implies that appropriate *Culicoides* spp. vectors are present in the state and that there is potential risk to other birds such as zoo and aviary populations, wild turkeys, and other game birds.**

* Introduction:
  + *Haemoproteus, Leukocytozoon, Plasmodium* are the three most commonly reported avian protozoan blood parasites.
  + *Haemoproteus:*
    - Transmitted by arthropods, infect mammals, reptiles, amphibians, birds.
    - Two subgenera – *Haemoproteus, Parahaemoproteus*, with different vectors.
      * H – Hippoboscids.
      * PH – Culicoides (biting midges).
    - *Haemoproteus* is the most common avian hemoparasite.
    - Traditional view that infections are largely nonpathogenic.
    - Can cause serious disease in pigeons, quail, turkeys.
    - Abortive *haemoproteus spp* infections in nonadapted avian hosts tend to be more severe.
    - Parasitemia highest in summer and fall, in habitats that support the insect vector.
    - Younger birds are more susceptible.
* M+M:
  + High mortality captive-bred Bobwhite quail on ranch in Utah (400 died).
    - 9 birds necropsied.
    - CS – depression, ruffled appearance, difficulty walking, or simply found dead.
    - Hemosporidian molecular analysis on pooled liver, lung, and trachea.
    - Gross necropsy – most prominent lesions pale skeletal muscle with multifocal hemorrhages and petechiae in air sacs and on serosal surfaces of most organs.
    - Moderate to severe degenerative myositis with intramyofiber schizonts and minimal lymphoplasmacytic infiltrates in the proventriculus, ventriculus, heart, and skeletal muscle.
    - Fibrinoid to heterophilic vasculitis in multiple organs with intraendothelial or intravascular merozoites and scattered thrombosis.
    - Liver and spleen multiple degenerative schizonts.
    - Mild, subacute, lymphocytic, histiocytic interstitial pneumonia.
    - Blood smears showed *Haemoproteus spp* in erythrocytes.
  + Molecular dx – subgenus *Parahaemoproteus.*
    - Closely related to forms found in Columbiformes, Passeriformes, and Strigiforme.
    - Vector was likely to be a *Culicoides spp.*
  + **In Bobwhite Quail in southern Utah, death was attributed to infection with *Parahaemoproteus* and the vector was likely to be a *Culicoides spp*.**
* Discussion:
  + This is an example of a virulent infection resulting from a **complete life cycle** of the protozoa.
  + Severe infestation in birds in CA lead to death by the schizont parasite stages in the liver (differs from milder disease that may result from anemia due to merozoite parasite stages in RBCs).
    - More malignant form of *haemoproteus* infection – leads to hemorrhages in liver and body cavity, results in severe blood loss and death.
    - In contrast to the quail, the *Parahaemoproteus* infection was not abortive.
      * Presence of numerous merozoites in sinusoids of the liver suggests asexual production was successful.

MacDonald, A. M., Jardine, C. M., Rejman, E., Barta, J. R., Bowman, J., Cai, H. Y., ... & Nemeth, N. M. (2019). High prevalence of Mycoplasma and Eimeria species in free-ranging eastern wild turkeys (Meleagris gallopavo silvestris) in Ontario, Canada. *Journal of wildlife diseases*, *55*(1), 54-63.

ABSTRACT: Following extirpation from Ontario, Canada in the early 1900s, Eastern Wild Turkeys (EWTs; Meleagris gallopavo silvestris) were successfully reintroduced to the province in 1984. Despite the subsequent establishment of robust populations and biannual hunting seasons, data on the circulation of potential pathogens in these birds are lacking. Similarly, the interface between EWTs and poultry is poorly understood and includes possible bidirectional pathogen transmission via direct or indirect contact. **Mycoplasma and Eimeria spp. are potential pathogens in Galliformes, and our objective was to determine their prevalence and distribution in Ontario EWTs. During the 2015 spring hunting season (April and May), oropharyngeal swabs from 147 hunter-harvested and five opportunistically collected EWTs from southern Ontario were cultured for Mycoplasma spp. The intestinal or cloacal contents of 107 of these birds and an additional 24 opportunistically and biologistcollected EWTs were analyzed for Eimeria spp. using PCR or fecal flotation. At least one Mycoplasma spp. was isolated from 98.7% (150/152) of EWTs, with six species identified. Mycoplasma gallopavonis was identified most commonly in 96.7% (147/152)**, followed by Mycoplasma gallinaceum in 23.7% (36/ 152). Potential poultry pathogens (Mycoplasma meleagridis, Mycoplasma iowae, and Mycoplasma synoviae) were isolated from swabs of five (3.3%) EWTs. Coinfections with up to three Mycoplasma spp. were detected in 36.8% (56/152) of EWTs. Most EWTs tested positive for Eimeria spp. oocysts (75.6%; 99/131). A subset of positive samples (n¼16) were characterized by PCR, which detected the following species: Eimeria meleagrimitis (93.8%), Eimeria adenoeides (93.8%), Eimeria gallopavonis (56.3%), and Eimeria meleagridis (12.5%). **The majority (93.8%) of these samples were positive for more than one Eimeria spp. We showed that numerous, mostly nonpathogenic Mycoplasma and Eimeria spp. circulate in EWTs across southern Ontario, and this helped to establish baseline information for comparison with future surveillance and monitoring**

Introduction:

* Important game species in Ontario with close interface between EWT and poultry flocks
* Mycoplasma and Eimeria spp can cause economic losses in the poultry industry.
  + Mycoplasma – Resp dz, decreased egg production and hatchability, embryonic mortality reduced wt gain, downgraded carcass quality.
  + Eimeria – Emaciation, lethargy, hemorrhagic diarrhea and (rarely) death.

M+M:

* Spring hunting season 2015 (April, May)
* Majority of carcasses in good body condition, no clinical signs reported/
* Oropharyngeal swabs collected from each carcass for Mycoplasma bacterial culture
* Intestinal contents collected for parasitology via McMaster’s and extracted DNA for PCR to ID Eimeria. Fecal flotation performed on cloacal contents.

Results

* At least one Mycoplasma spp. isolated from 150/152 birds.
  + *M. gallopavonis* most common (98.7%), next *M. gallinaceum* (23.7%)
  + Pathogenic Mycoplasma species in this study was rare (*M. meleagridis, M. synoviae and M. iowae*); 5% individuals. High % of non-pathogenic Mycoplasma and Eimeria species in EWT
  + Many Mycoplasma spp considered commensals of the resp tract in poultry.
  + High prevalence consistent with other studies in CO, NC, OK, TX.
  + First report of isolation of M. meleagridis and M. iowae from EWTs.
  + Skewed toward males due to hunter-harvest regulations
* Overall prevalence *Eimeria spp*. in intestinal/cloacal contents was 75.6%, mean 175 OPG (low).
* Coinfections 36.8%.

Discussion

* Potential for economic losses from Mycoplasma and Eimeria infection of poultry as well as poor biosecurity in farms
* *M. meleagridis, M. synoviae, M. iowae and M. gallisepticum* potential pathogens of wild and domestic turkeys.
  + *M. meleagridis* infection often subclinical in adults, young birds suffer from resp disease, poor growth, bone deformations.
  + *M. synoviae* – Synovitis and resp disease in domestic chickens, turkeys.
  + *M. iowae* – Embryonic mortality, joint-related growth abnormalities in legs, air sacculitis in wild and domestic turtkeys.
  + *M. gallisepticum* – Most well-documented Mycoplasma spp in NA birds, most notably house finches, Chukar partridges, ring-necked pheasants.
* Severity of infection with Eimeria dictated by infecting spp and number of oocysts ingested. Clinical coccidiosis reports in EWTs are limited to captive birds.
* Environmental and ecological differences between domestic and wild turkeys i.e. population density, habitat, foraging behavior, diet likely affect diversity of *Eimeria spp* and oocyst quantities in which they contact.

**Risk factors for and spatial distribution of lymphoproliferative disease virus (LPDV) in wild turkeys (Meleagris gallopavo) in New York State, USA**

Alger K, Bunting E, Schuler K, Whipps CM.

Journal of wildlife diseases. 2017 Jul;53(3):499-508.

**Taxonomy:** Galliformes → Phasianidae

**Abstract:** Lymphoproliferative disease virus (LPDV) is an oncogenic avian retrovirus that was previously thought to exclusively infect domestic turkeys but was recently shown to be widespread in Wild Turkeys (Meleagris gallopavo) throughout most of the eastern US. In commercial flocks, the virus spreads between birds housed in close quarters, but there is little information about potential risk factors for infection in wild birds. Initial studies focused on distribution of LPDV nationally, but investigation of state-level data is necessary to assess potential predictors of infection and detect patterns in disease prevalence and distribution. We tested wild turkey bone marrow samples (n=2,538) obtained from hunter-harvested birds in New York State from 2012 to 2014 for LPDV infection. Statewide prevalence for those 3 yr was 55% with a 95% confidence interval (CI) of 53–57%. We evaluated a suite of demographic, anthropogenic, and land cover characteristics with logistic regression to identify potential predictors for infection based on odds ratio (OR). Age (OR=0.16, 95% CI=0.13–0.19) and sex (OR=1.3, 95% CI=1.03–1.24) were strong predictors of LPDV infection, with juveniles less likely to test positive than adults, and females more likely to test positive than males. The number of birds released during the state’s 40-yr translocation program (OR=0.993, 95% CI=0.990–0.997) and the ratio of agriculture to forest cover (OR=1.13, 95% CI=1.03–1.19) were also predictive of LPDV infection. Prevalence distribution was analyzed using dual kernel density smoothing to produce a risk surface map, combined with Kulldorff’s spatial scan statistic and the Anselin Local Moran’s I to identify statistically significant geographic clusters of high or low prevalence. These methods revealed the prevalence of LPDV was high (.50%) throughout New York State, with regions of variation and several significant clusters. We revealed new information about the risk factors and distribution of LPDV in New York State, which may be beneficial to game bird managers and producers of organic or pasture-raised poultry.

**Background:**

* Lymphoproliferative disease virus (LPDV) = oncogenic retrovirus that causes neoplasia in wild and domestic fowl
  + Endemic in wild turkeys
* LPDV causes internal and cutaneous tumors
  + Mass mortalities in domestic flocks
  + Rarely fatal in wild turkeys
* Transmission: horizontal +/- vertical (seen in other retroviruses)
* No vaccine available

Key Points:

* Overall prevalence of LPDV in wild turkeys = 55%
  + Females > males
  + Older > juveniles
  + Increased with increased agriculture:forest
* Prevent LPDV with adequate fencing around farms in areas of high prevalence
* Uncertain if translocation affected distribution of the virus.

**Conclusions:** Lymphoproliferative disease virus is endemic in wild turkeys in New York.

**Detection of lymphoproliferative disease virus in Canada in a survey for viruses in Ontario wild turkeys (Meleagris gallopavo).**

MacDonald AM, Jardine CM, Bowman J, Susta L, Nemeth NM.

Journal of wildlife diseases. 2019 Jan;55(1):113-22.

**Taxonomy:** Galliformes → Phasianidae

**Abstract:** The successful reintroduction of Wild Turkeys (Meleagris gallopavo) to Ontario, Canada, has led to established populations in southern portions of the province and currently allows for biannual hunting seasons. These populations geographically overlap Domestic Turkey farms, an important sector of the provincial agri-food industry. Potential pathogen transmission between Wild Turkeys and Domestic Turkeys (Meleagris gallopavo) is a concern, because they are susceptible to infection with many of the same pathogens and have direct and indirect contact in outdoor or open farm settings and contaminated environmental substrates. However, data concerning potential poultry pathogens in Wild Turkeys in Canada are scarce. Thus, we assessed the prevalence and geographic distribution of geographically relevant viruses in Ontario Wild Turkeys. Oropharyngeal and cloacal swabs were tested for avian influenza viruses (AIV) by real-time reverse transcriptase (RT)-PCR (n=207), pooled tissues for lymphoproliferative disease virus (LPDV; n=183) and reticuloendotheliosis virus (n=119) by PCR, and gross skin lesions by real-time RT-PCR for avian poxvirus (n=8). We sequenced a fragment of the gag polyprotein (p31) gene of LPDV on a subset (n=10) of LPDV-positive samples for phylogenetic analysis and tested additional upland game bird species (n=39) and domestic fowl for LPDV (n=17). To the best of our knowledge, we document the first detection of LPDV in Wild Turkeys in Canada, with a prevalence of 65% (119/183). Phylogenetic analysis revealed that LPDV sequences from Ontario were genetically similar to other North American strains and did not group into separate clades. Reticuloendotheliosis virus was detected in 4% (5/119) of LPDV-positive Wild Turkeys. Grossly evident skin lesions from five Wild Turkeys tested positive for poxvirus, and all turkeys tested negative for AIV. This study provides evidence of LPDV circulation in Canada and provides a baseline for comparison with future Wild Turkey pathogen surveillance and monitoring in Ontario and elsewhere.

**Background:**

* Lymphoproliferative disease virus = oncogenic virus in wild and domestic turkeys
  + Endemic in wild turkeys → subclinical disease
* Avian influenza = orthomyxovirus that is maintained in aquatic migratory birds
* Avian poxvirus is spread through direct contact or arthropod vectors

**Key Points:**

* LPDV was common (65% prevalence) in wild turkeys
  + Males > females
  + Strains genetically similar to other North American strains and not Old World strains
  + No LPDV in other bird species tested
* Wild turkeys with proliferative skin lesions were likely to test positive for avian poxvirus
* Few cases of reticuloendothelial virus
* No cases of avian influenza

**Conclusions**: Wild turkeys in Canada have a high prevalence of lymphoproliferative disease virus.