

LAB LINES

Diagnostic news and trends from the Colorado State University Veterinary Diagnostic Laboratories
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Food Animal Production Medicine

New Field Investigation Unit Puts Multidisciplinary Medicine to Work

— Charlie Davis, DVM, CSU VDL Lab Coordinator

The concept of “production livestock veterinary medicine”—care that shifts focus from strictly clinical medicine to a multidisciplinary focus on the farmer’s management and ultimately profit—has spread only slowly through veterinary academia. The vision of the new CSU Field Investigation Unit is to actively bring all the university’s multidisciplinary veterinary resources to bear on production problems faced by Colorado livestock producers, identify underlying production or disease issues and solve them with research-based strategies.

A collaboration of personnel from the agriculture school’s Department of Animal Sciences, the veterinary college’s Department of Clinical Sciences and the Veterinary Diagnostic Laboratories, the unit invites livestock owners or attending veterinarians to request assistance with a disease problem or production issue they feel is beyond the scope of locally available resources. The investigative unit will be available at all times, with points of contact available in each of the participating departments.

Once a problem is presented and defined, a team will be assembled from the unit roster that best employs the expertise available. The Field Investigation Unit will aim not only to resolve the current problem as presented, but also to formulate comprehensive plans and recommendations for future, preventive use.

“We understand livestock production is complex,” said VDL Director Barb Powers, in announcing the new consultation service during the Colorado Cattlemen’s Association 2014 Mid-Winter Conference. “To be suc-

cessful, producers simultaneously pursue best practices in systems management, nutrition, disease prevention and other aspects of health and husbandry. Those of us at CSU want to support producers by considering problems and solutions in a very comprehensive way.”

In one of its first cases, Field Investigation Unit members took part in a conference call with a commercial cow/calf producer whose young cows and heifers were failing to conceive, while older cows had few fertility problems. He feared an infectious disease.

But as team members asked questions and discussed the problem with the producer, they determined the infertility was likely rooted not in infection, but in nutrition and management. They suggested new approaches to pasturing and calving, improved rations and vitamin and trace-mineral forage testing. Members of the Field Investigation Unit will also follow up with the Colorado rancher during the next calving season to ensure the fertility trouble has resolved.

The new unit satisfies the mission of the VDL and the broader university on several levels. It will contribute to the continued vitality of the livestock sector of Colorado’s \$41 billion annual agricultural industry. It will further improve both timeliness and quality of service received by the client. It will further outreach and student involvement. And it will point to a need for further research into areas of livestock production in the state and region.

TO REACH THE FIELD INVESTIGATIVE UNIT

■ Veterinary Diagnostic Laboratories

• Charlie Davis
(970) 297-0370
(970) 689-1632
charlie.davis@colostate.edu

• Barb Powers
(970) 297-1285
(970) 221-5729
barb.powers@colostate.edu

■ Livestock Medicine, James L. Voss Veterinary Teaching Hospital

• (970) 297-5000
Extension 1 during business hours
Extension 2 after business hours

■ Department of Animal Sciences

• Jason Ahola
(970) 491-3312
jason.ahola@colostate.edu

• John Wagner
(970) 491-2174
john.wagner@colostate.edu



Canine Oncology Innovations

What Lymphoma is this, and Why does it Matter?

— Anne Avery, DVM, PhD, CSU Associate Professor of Microbiology, Immunology and Pathology

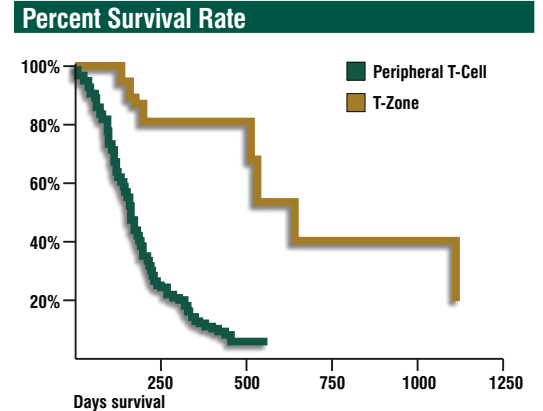
It has become common to divide LPD, or lymphoproliferative disorders—the collective term for lymphoma and leukemia—into “B cell” and “T cell,” with the understanding that T cell lymphomas have a worse prognosis. This idea, however, needs to be re-examined.

Proper classification of LPD can greatly facilitate decisions about whether to treat LPD—some owners may decide not to treat in the face of a poor prognosis. Some indolent LPD can be monitored without therapy. Proper classification of LPD can also guide, in some cases, the type of treatment chosen.

The World Health Organization recognizes over 50 different types of LPD in people, and a study in 2011 indicates that many of these types can be found in dogs.¹ Such diversity occurs because each type of lymphoma arises from a lymphocyte at a separate stage of differentiation.

Different types of lymphoma can have dramatically different outcomes and treatment options. Three of the most common types of B cell LPD are diffuse large B cell lymphoma, marginal zone lymphoma and B cell chronic lymphocytic leukemia (CLL), or small cell lymphoma. Diffuse large B cell lymphoma has a median survival of approximately one year when treated with CHOP chemotherapy.² Marginal zone lymphoma, however, has a median survival of two years³ and B cell CLL has a median survival of greater than three years.⁴ Both diseases can be treated with prednisone and chlorambucil, rather than a more aggressive protocol.³

T-cell lymphomas are also highly heterogeneous.



The high heterogeneity of T-cell lymphomas leads to differing progression in the disease and different choices in treatment.

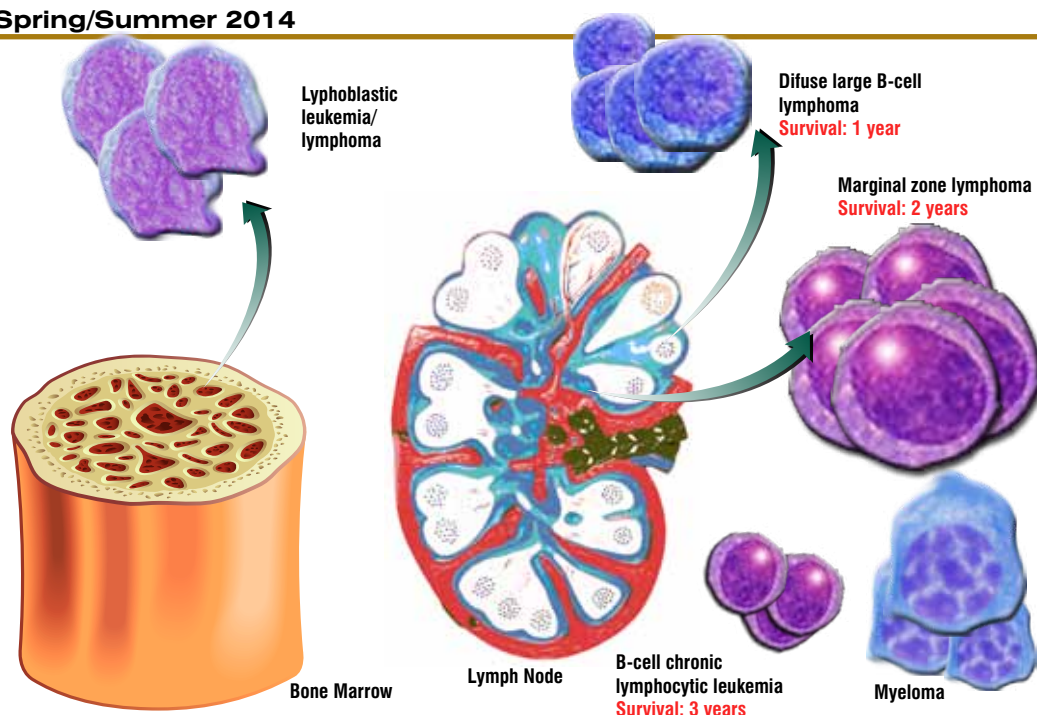
Take, for example, two different types of T cell lymphomas shown in the chart above—although many additional forms exist. The first, peripheral T cell lymphoma, has an overall median survival of 150 days when dogs are treated with multi-drug therapy.⁵ This type of lymphoma is particularly common in Boxers with a median age of 7 years, and it often features hypercalcemia or a mediastinal mass. It is most likely derived from T cells at an early stage of development.

The second type of lymphoma is called T zone lymphoma. Four in 10 T zone cases are in golden retrievers with a median age of 10.⁶ This form of T cell lymphoma has an indolent course, with patients often not

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4. Williams MJ, Avery AC, Lana SE, et al. Canine lymphoproliferative disease characterized by lymphocytosis: immunophenotypic markers of prognosis. *J Vet Intern Med* 2008;22:596-601.
5. Avery PR, Burton J, Bromberek JL, et al. Flow cytometric characterization and clinical outcome of CD4+ T-Cell lymphoma in dogs: 67 cases. *J Vet Intern Med.* 2014 Mar-Apr;28(2):538-46.
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Which test do I choose?			
	Pros	Cons	Cost
Flow cytometry	<ul style="list-style-type: none"> ✓ Sample is easy to obtain without anesthesia ✓ Assay is objective ✓ Can provide prognostic information for many, but not all types of LPD in dogs ✓ Can be carried out on blood without a lymph node aspirate if the CBC indicates lymphocytosis or blasts in the blood 	<ul style="list-style-type: none"> ✗ Cannot distinguish certain types of B cell lymphomas (diffuse large B cell versus marginal zone) ✗ Cells must be alive, so samples need to be shipped overnight on ice ✗ Offered by restricted number of labs (CSU Clinical Immunology is the largest provider of this service) 	\$115
Histology/Immunohistochemistry	<ul style="list-style-type: none"> ✓ Formalin fixation means sample does not require special shipping or handling ✓ Can classify more lymphoma subtypes than flow cytometry ✓ Available from most reference labs 	<ul style="list-style-type: none"> ✗ Usually requires sedation/anesthesia, so can be more expensive ✗ More subjective than flow cytometry 	\$114



Since an initial LPD diagnosis is often made from a fine-needle aspirate, consultation with clinical pathology can be helpful before deciding what test to submit for further classification.

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requiring chemotherapy for months. When dogs show clinical signs and chemotherapy is instituted, some data indicate prednisone and chlorambucil is as effective as more expensive and aggressive protocols.³

TESTING OPTIONS

How can you tell what type of LPD is afflicting your patient? Two tests can help classify a dog's LPD:

- Flow cytometry, which is performed on a lymph node aspirate or blood using fluorescent labeled antibodies to different cell surface proteins. Flow cytometry identifies different types of lymphoma

by the constellation of proteins cells express on the surface.

- Histology/immunohistochemistry, which is performed on a biopsy and includes staining for B and T cell subsets. Histology identifies different types of lymphoma by their cell size, morphology and the architecture of the malignant node.

The choice of test depends on the owner's circumstances and where the primary disease manifests. Since initial diagnosis is often made from a fine-needle aspirate, consultation with clinical pathology can be helpful before deciding what test to submit for further classification.

To discuss a case of suspected LPD, call the clinical immunology lab at (970) 491-1170.

You can also find more information at csu-cvmb.colostate.edu/academics/mip/ci-lab

Food Animal Production Medicine

High-Country Calf Mortality

Producer reports from ranches over 2,438 meters altitude in southwest Colorado suggest mortality of preweaned beef calves may be substantially higher than the national average, despite a history of selecting herd sires adapted to low pulmonary pressure. Diagnostic investigations have been limited due to the extensive mountainous terrain over which these calves are grazed with their dams. The objective of our study was to determine the causes of calf mortality on five high-altitude ranches in Colorado that have been selectively breeding sires with low pulmonary pressure of less than 45 mm Hg for over 20 years. Calves were followed from spring branding at 6 weeks old to fall weaning at 7 months old. We recorded clinical signs, took blood samples from sick calves, performed postmortem examinations and submitted select tissue samples for aerobic culture or histopathology.

— Dan Gould, DVM, PhD, CSU Microbiology, Immunology and Pathology Professor Emeritus; Joe Neary, MA, MS, VetMB, CSU Integrated Livestock Management.

On the principal study ranch, 9.6 percent, or 59 of 612 calves, that were branded in the spring either died or were presumed dead by weaning in the fall. In total, 28 necropsies were performed. Half of those had lesions consistent with pulmonary hypertension and right-side heart failure, and half died from bronchopneumonia. Remodeling of the pulmonary arterial system, indicative of pulmonary hypertension, was evident in the former and to varying degrees in the latter.

There is a need to better characterize the additional risk factors that complicate pulmonary arterial pressure testing of herd sires as a strategy to control pulmonary hypertension.



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Chemistry and Toxicology

As Livestock Producers Dip into Low-Quality Forages, Beware Nitrate

— Gene Niles, DVM, DABVT, Director,
CSU VDL Rocky Ford Branch

References:

- **Toxic Plants of North America;** Burrows and Tyrl, Iowa State Press, 2001
- **Clinical Veterinary Toxicology;** Plumlee; Mosby; 2004; p 127-130
- **Cattlemen's Day 1990;** progress report 592; Agriculture Experiment Station, Kansas State University
- **Nitrate and Nitrite Toxicity in Horses;** News: Kentucky Equine Research
- **Nitrates in Livestock Feeding;** NebGuide, G1779; University of Nebraska Lincoln
- **Alpaca plant poisoning: nitrate-nitrite and possible cyanide;** Australian Veterinary Journal Vol 87, No 3, March 2009, p 113-115

Even with the continuing drought in Southeastern Colorado, greater than 99 percent of the total 1,376 forage samples CSU VDL's Rocky Ford laboratory analyzed for nitrate concentrations over the last two years could be fed to livestock either as is or by diluting with low nitrate forages. That leaves less than 1 percent considered not safe to feed.

Although this pattern remained constant through the first two months of 2014, since the first of March we have received samples of corn stalks, sudan hay, oat hay and pigweed that contained from 17,000 ppm nitrate to over 60,000 ppm nitrate. This pattern is continuing, with more samples measuring in the 5000 to 10,000 ppm range than in the first two months of 2014. It seems this pattern is unlikely to change anytime soon, as producers have exhausted their forage supplies and are forced to feed very poor quality forages.

Therefore, producers should not assume forages are safe for use without testing. The consequences can be costly. Just in the last month we have seen cases of nitrate poisoning with multiple death losses and abortions from cows that exhibited clinical illness. In one instance, the cattle were turned into a pasture heavily contaminated with pigweed which contained more than 60,000 ppm nitrate. A similar incident occurred when cows were fed hay comprised primarily of pigweed that had 19,000 ppm nitrate. Six cows died in less than 12 hours after they were fed recently purchased sudan hay. The cows' ocular fluid contained more than 50 ppm nitrate, confirming nitrate poisoning as the cause of death.

TESTING REMAINS THE BEST STRATEGY

Testing forages for nitrate content is still the only way to try to prevent such losses from occurring.

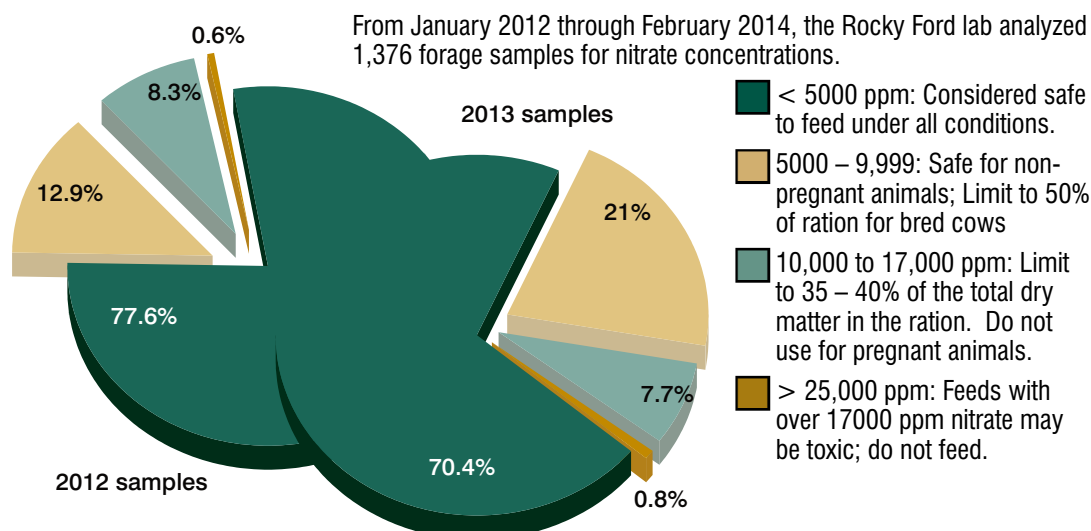
When to test. Nitrate levels in plants increase during periods of plant stress and impaired growth. A wide variety of plants including many common grasses, winter forages, hay and crop residues are known to accumulate toxic levels of nitrate, especially after heavy applications of nitrogen fertilizers. Herbicide application can increase the level of nitrate in row crops and weeds. It is not unusual for sorghum sudan hay grown on heavily fertilized crop fields to contain greater than 6000 ppm nitrate even when adequately irrigated. Nitrate poisoning is most likely to occur when cattle are in poor body condition and being maintained on low energy diets. Adverse weather conditions potentiate nitrate poisoning.

What to test. Sorghum sudan hybrids, millet, oat hay, corn and milo stalks and a multitude of weeds—primarily kochi, pigweed and thistles—comprise the bulk of the nitrate testing done at the Rocky Ford CVM VDL. The effects of nitrates in feed and water are additive, and both sources should be considered. High nitrate forages should not be fed when cattle are exposed to high nitrate water.

How to test. Quite often we receive a single plant from a field or sample of hay from one bale to test for nitrate. This practice is discouraged, as an extremely wide variation in nitrate levels can occur throughout a particular field. Kansas State University reported that in a field of drought-stressed sudan, some bales contained more the twice the average nitrate level for the entire field. When taking pre-harvest samples, several samples taken at the level of expected harvest (do not include roots) should be taken from throughout the field. When there are major differences in plant growth within a field, it is best to divide the field into areas according to growth and test them individually so areas with plants high in nitrate can be identified and managed accordingly. With post-harvest samples, core samples from a number of bales should be combined and analyzed. Results from single grab samples taken from the exterior of one or two bales should not be relied on to represent the entire lot.

Which animals to target. Although nitrate poisoning has occurred in cattle consuming forages with less than 5000 ppm nitrate, the general recommendation is that forages with up to 10,000 ppm, or 1 percent, nitrate are considered safe to feed to non-pregnant cattle that have been acclimated to the high nitrate feed. Cattle in poor body condition consuming low energy diets are most susceptible to nitrate poisoning. Sheep are less susceptible than cattle. Nitrate poisoning has also been reported in goats and alpacas. Although a few references consider horses to be as susceptible to nitrates as ruminants, other reports state that no harmful effects occurred in pregnant and open mares consuming forages containing from 25,000 to 35,000 ppm nitrate over a period of several months. Others have reported no ill effects in horses consuming high nitrate forages that killed cows fed the

2012-2013 Rocky Ford Nitrate Levels in Forages



same hay. A Kentucky Equine Research News publication lists 20,000 ppm as the level of concern for horses. High nitrate forages do not pose a risk to other non-ruminants.

How to interpret and use results. Results are reported in a variety of ways—in either percentages or as parts per million and in units of either nitrate, nitrate-nitrogen or potassium-nitrate. To correctly interpret nitrate results, be sure the units of measurement on the laboratory report match the reference chart in use:

- Percentage times 10,000 equals ppm; ppm divided by 10,000 equals percentage.
- Ppm nitrate-nitrogen times 4.4 equals ppm nitrate.
- Ppm nitrate times by 0.23 equals ppm nitrate-nitrogen.
- Ppm potassium nitrate times 1.63 equals ppm nitrate.

10 FACTORS RELATED TO NITRATE TOXICITY

- All plants contain nitrate, but under stress certain forages—corn, sorghum, oats, soybeans, millet, sudan and sorghum/sudan hybrids—can accumulate toxic levels. Pigweed, Canadian thistle, kochia, ragweed and other weeds also tend to accumulate nitrate.
- Nitrate content varies widely throughout the plant but is greatest in the lower third of the stalk.
- Concentration is usually high in young plants and decreases as the plant matures. However, at high levels of soil nitrate or under conditions of stress, content may be high at maturity. Highest levels occur just before flowering and decline rapidly after pollination and seed formation.
- Abrupt setbacks to growth, like drought or freezing, may result in high nitrate. Lack of sunlight, temperature extremes or hail damage can also increase levels.
- Levels increase immediately after a drought-breaking rain; therefore, harvest should be delayed for a week.
- When silage is made from high nitrate forages, anaerobic fermentation converts nitrate to ammonia,

Recommendations for the maximum safe level of nitrate in forages fed to pregnant cows range from 4400 ppm to 9300 ppm. Many references recommend forages with nitrate levels ranging from 5000 to 9300 ppm be limited to less than 50 percent of the dry matter for pregnant cows, while others consider these levels safe if cows are acclimated to the high nitrate. Controlled studies have failed to demonstrate abortions in cows that do not show clinical signs of illness, but it's best to keep nitrate levels in forages fed to pregnant cows below 5000 ppm.

Cattle can adapt to increased nitrate levels in their diets in as little as seven days. Once acclimated, cattle should remain on a constant level of nitrate, as acclimation can be lost as quickly as it is gained.

significantly reducing the nitrate content. Levels in properly ensiled forages can decrease by 30 percent to 60 percent over a month or two. Forages with significantly elevated nitrate levels at harvest should be retested before fed.

7 Green chop should be fed as soon as possible. Storage heating can convert nitrate to nitrite—the toxic agent in nitrate poisoning—increasing potential toxicity up to ten times.

8 To analyze harvested hay or silage, take a composite sample from six to eight different bales or locations in the silo. Cored samples are preferred on bales.

9 The effects of nitrate levels in forage, feed and water are additive. Livestock water containing 1,000 ppm nitrate can contribute to nitrate poisoning even when feed contains only moderate levels.

10 High energy feeds and gradual introduction to high nitrate feeds will increase tolerance. Healthy animals have a higher resistance than ill or poorly nourished animals.

NITRATE TESTING AT CSU

FEED SAMPLES

- Composite sample from six to eight different bales or silo locations. Cored samples preferred on bales.

COST

- \$10 per sample

TURNAROUND

- Same-day in most cases

WATER SAMPLES

- 50 mL in a leakproof container

COST

- Stand-alone: \$11 per sample

- Livestock Water Screen: \$20

TURNAROUND

- 24 business hours



Clinical signs of acute nitrate poisoning include difficult breathing, chocolate-brown colored blood and mucus membranes, muscle tremors, weakness, reduced exercise tolerance, incoordination, collapse and sudden death.



CSU VDL in the Field: Case Study

Sodium Intoxication in a Ewe

A 4,500-head commercial sheep ranch in southeastern Wyoming presented a 4-year-old, lactating crossbreed ewe for evaluation of six hours of recumbency and obtunded mentation. A second ewe showing similar signs earlier that day had died without treatment, but the carcass was not available for examination. The ewe had given birth to two healthy lambs 17 days prior to illness onset, one of 30 ewes and 54 lambs that had been moved into a 10-acre, fenced grass pasture the previous evening.

The ewes and lambs had been corralled for about 14 days before being pastured. While in the corral, they were provided ad lib grass hay and water pumped into troughs from a nearby stream. The pasture contained a mixture of native grasses and shrubs, and access to the same stream was provided at a corner of the pasture. A tub of loose salt, not supplemented with trace minerals or medications, was present in the center of the pasture. A fenced-in shed was present in the center of the pasture; the ewes and lambs had been gathered the previous night and confined within the shed during the previous night. Inspection of the pasture revealed no toxic plants or materials. The ewes were immunized annually for tetanus and *Clostridium perfringens* C and D, with the most recent booster administered two months before.

Physical examination revealed a recumbent, thin, severely obtunded ewe with a normal heart rate, respiratory rate and rectal temperature. Hydration status, mucous membrane color, and capillary refill time were normal. Neurologic examination revealed fasciculations of the facial muscles and variable, bilateral nys-

— Dave Van Metre, DVM, DACVIM, CSU Animal Population Health Institute Professor

tagmus. Vision, pupillary light responses, muscle tone and spinal reflexes were normal.

The ewe's venous blood sample glucose concentration, as determined by a portable glucometer, was 404 mg/dl, compared to a normal of 70 to 100. A sample of cerebrospinal fluid was obtained by lumbosacral puncture. Differential diagnoses included head trauma, listeriosis, bacterial meningitis, rabies, salt intoxication or water deprivation, and type D enterotoxemia. Dexamethasone at 0.1 mg/kg IV, oxytetracycline at 11 mg/kg IV and 20 cc SC *Clostridium perfringens* types C and D antitoxin were administered. The ewe died about one hour after treatment.

Brain-tissue fluorescent antibody testing for rabies virus was negative. Gross necropsy revealed multiple pulmonary and mediastinal abscesses suggestive of caseous lymphadenitis. Serum biochemical analysis revealed hypernatremia (serum sodium concentration, 195 mEq/l; normal, 142-152), hyperchloridemia (152 mEq/l; normal, 103-113), hyperglycemia (serum glucose concentration, 419 mg/dl) with normal serum calcium and magnesium concentrations. Serum activities of hepatic and muscle enzymes were within normal limits. Analysis of cerebral spinal fluid revealed no cytologic abnormalities; however, the sodium concentration of the fluid was 195 mEq/l (normal, < 160), suggesting salt intoxication.

Histopathologic examination of cerebrum, cerebel-

lum and brainstem revealed perivascular edema and occasional perivascular hemorrhage. The sodium concentration of brain tissue was 10,500 ppm, compared to a normal of 5,500 to 5,700 ppm, leading to a diagnosis of acute sodium intoxication.

Interview of the shepherd responsible for the affected ewes revealed that on the evening prior to the onset of signs, he had moved the group from the corrals into the grass pasture. The shepherd observed several ewes vigorously ingesting the loose salt; however, he had moved the ewes into the overnight enclosure without allowing the animals access to water. Apparently, the affected ewe had voluntarily ingested sufficient amounts of salt to induce acute sodium intoxication. Loss of free water

from the ewe's extracellular fluid space likely occurred overnight through insensible losses and lactation, which likely further exacerbated the high sodium to ECF water relationship in the ECF—in other words, the hyponatremia. The hyperglycemia detected prior to the ewe's death was indicative of a stress response.

Given that the ewes had only been allowed access to ad libitum hay and water while being held in a corral for two weeks, it is likely that significant salt hunger had developed, potentially contributing to intoxication. To correct this problem, salt supplementation of the flock was initiated in all corrals and pastures, and salt tubs were moved to be located near water supplies in all pastures. No additional cases occurred.

CSU VDL in the Field: Disease Updates

Canine Pheochromocytomas

Pheochromocytoma associated catecholamine-induced cardiomyopathy is a well-recognized entity in man and has been described in mice and non-human primates. But it has not yet been identified or described in dogs.

In our retrospective study, we identified nine dogs with histologically confirmed pheochromocytomas and concurrent cardiovascular pathology observed histologically (n=6), echocardiographically (n=4) or electrocardiographically (n=5).

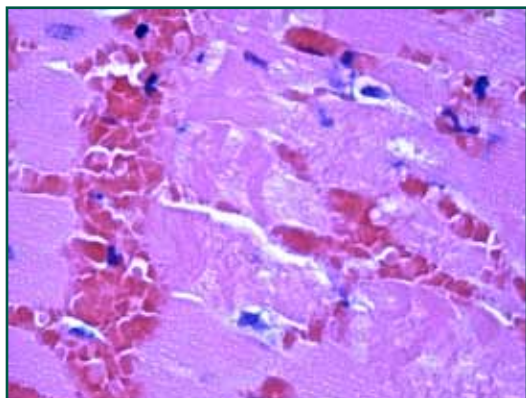
Histopathology included multifocal cardiomyocyte necrosis with contraction bands, cardiomyocyte degeneration, myocardial hemorrhage, lymphohistiocytic myocarditis and interstitial fibrosis. Clinical procedures including electrocardiographic and echocardiographic examinations, Doppler blood pressure measurement, and auscultation were available for five dogs and consistently revealed concentric or mixed—eccentric and concentric—ventricular hypertrophy. Additional observed changes included arrhythmias, systemic

— *Elijah Edmondson, DVM, PhD, CSU VDL Anatomic Pathology Resident; and EJ Ehrhart, DVM, PhD, DACVP, CSU VDL Pathologist*

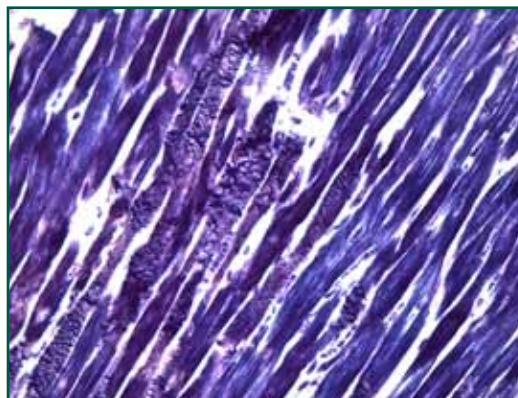
hypertension and heart murmurs. The myocardial lesions observed in this series of dogs are similar to those observed in humans with pheochromocytoma



associated catecholamine-induced cardiomyopathy. Catecholamine-induced cardiac disease is reversible with medical treatment; therefore, recognition of this cardiomyopathy has the potential to reduce morbidity and mortality in dogs with pheochromocytomas.



Necrotic cardiomyocytes are characterized by sarcomeric architecture disruption with myofibrillar rhexis and coagulation.



Hypercontracted, coagulated sarcomeres result in contraction band formation, HE and PTAH.

Edmondson EF, Bright J, Halsey C, Ehrhart EJ. Pathologic and cardiovascular characterization of pheochromocytoma associated catecholamine-induced cardiomyopathy in dogs. In press.

Exotics Medicine

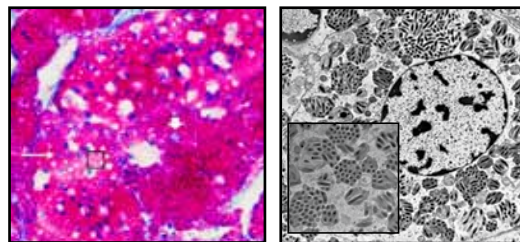
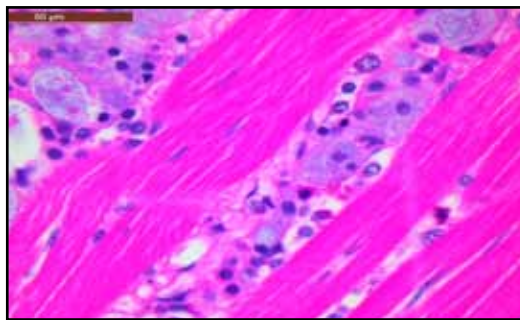
Rickettsia in an Emperor Scorpion?

An adult male emperor scorpion was received for necropsy from an arachnid collection in which two scorpions and one tarantula had recently died due to necrotizing, bacterial enteritis. This scorpion presented clinically with a brief, two-day history of marked listlessness and weakness, including inability to lift



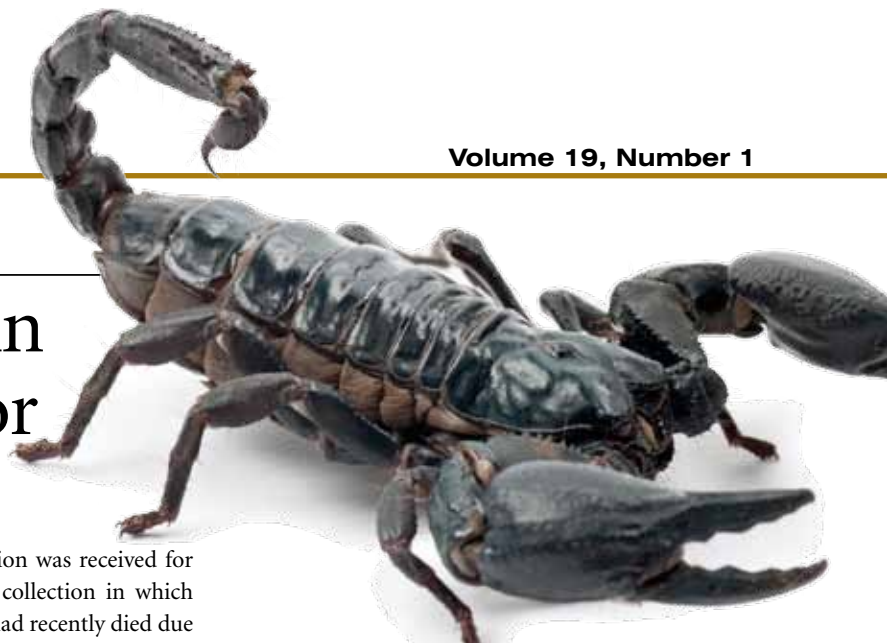
the tail. Upon death, the coelom was opened and swabbed for in-house aerobic culture, which was negative for growth. The body was placed in formalin for fixation and further prosection.

The most notable histopathologic finding was large numbers of pale, granular phagocytic-like cells filling the hemolymph in all sections and multifocally infiltrating the fat bodies and skeletal muscle, particularly of the



(Clockwise from top)

- Pale, granular phagocytic-like cells filled the hemolymph in all sections and multifocally infiltrated the fat bodies and skeletal muscle, particularly of the mesosoma.
- Granular intracytoplasmic material consisted of numerous cytoplasmic vesicles containing tightly packed bacilliform organisms of about 350 by 60 nanometers.
- Granular intra-histiocytic material was strongly acid fast positive, highlighting numerous small intra-cytoplasmic rods.



—Sushan Han, DVM, PhD, DACVP, CSU VDL Pathologist;
Anibal Armien DVM, MS, PhD, DACVP

mesosoma, or mid-section. Phagocytic cells were stained for micro-organisms using a panel of histochemical stains. Granular intra-histiocytic material was strongly acid fast positive, highlighting numerous small intra-cytoplasmic rods. Intracytoplasmic material was non-Gram staining and silver-negative. Systemic granulomatosis with possible intracytoplasmic organisms was diagnosed.

Using the University of Minnesota Veterinary Diagnostic Laboratory's transmission electron microscopy to produce high quality detailed images, we confirmed the phagocytic cells to be of macrophage lineage. The granular intracytoplasmic material consisted of numerous cytoplasmic vesicles containing tightly packed bacilliform organisms of about 350 by 60 nanometers. Although initially these acid-fast organisms were thought to be most consistent with *Mycobacterium*, *Mycobacteria* are significantly larger, at generally 1 to 4 micrometers. A differential etiologic diagnosis included intra-histiocytic bacilliform virus infection. Bacilliform viruses include Ascovirus, Baculovirus, and Nudivirus species. These large viruses are histologically similar in size and morphology to those we detected; however, bacilliform viruses should be closely associated with the nucleus, forming intra-nuclear inclusion bodies at certain stages, as well as replicative phases that occur in close association with the nucleus. Our macrophage examination, in contrast, showed these organisms proliferated within intracytoplasmic vesicles with no nuclear association.

Mycobacterium PCR on formalin-fixed paraffin embedded tissue with phagocytic cells submitted to Washington State University's diagnostic lab was universally negative. However, when PCR primers for other small, intracellular and possible acid-fast positive bacteria were then employed, results using *Rickettsia* sp. primers were strongly positive. Additional speciation of this possible *Rickettsia* organism is currently underway. This is thought to be a novel *Rickettsia* species infecting a scorpion, an arachnid for which rickettsial disease has not been previously described.

CSU VDL In Press

A Roundup of VDL Faculty Research

Burgess BA, Noyes NR, Bolte DS, Hyatt DR, Van Metre DC, Morley PS. Rapid Salmonella detection in experimentally-inoculated equine faecal and veterinary hospital environmental samples using commercially available lateral flow immunoassays. *Equine Vet J.* 2014 Feb 9. doi: 10.1111/evj.12234.

VDL Bacteriology Section Head Doreene Hyatt participated in a Department of Clinical Sciences study that first inoculated horse feces and environmental swabs



from the floor of a building next door to the teaching hospital with a *Salmonella enterica* serotype Typhimurium from a former equine patient, and then tested them using one of two commercial rapid-diagnostic tests kits marketed for *S. enterica*

detection in meat, poultry and chicken feed. The cheap and quick lateral-flow immunoassays use antibodies specific for surface antigens of *Salmonella* and colloidal gold-antibody conjugates incorporated into test strips. Their study showed the strips could reliably detect *S. enterica* within 18 hours, indicating they may be useful for rapid point-of-care testing to allow managers to implement measures more effectively to decrease animal and zoonotic infections in hospitals, racetracks, shows and other high-risk areas where horses congregate and shed the bacteria.

Hoon-Hanks LL, Regan D, Dubey JP, Carol Porter M, Duncan CG. Hepatic neosporosis in a dog treated for pemphigus foliaceus. *J Vet Diagn Invest.* 2013 Nov;25(6):807-10. doi: 10.1177/1040638713507257.

VDL Pathologist Colleen Duncan led this case study on a 4-year-old spayed Border Collie diagnosed three months prior with pemphigus foliaceus, receiving combination immunosuppressive therapy, and presented for progressive lethargy, inappetence and weakness, which subsequently led to elective humane euthanasia. Gross postmortem examination revealed a diffusely pale tan to slightly yellow, enlarged, markedly friable liver with an enhanced reticular pattern. Histologically, the hepatic changes consisted of multifocal to coalescing areas of severe vacuolar degeneration, numerous coalescing foci of hepatocellular necrosis, and myriad intra- and extracellular protozoa that reacted immunohistochemically with polyclonal antibodies to *Neospora caninum*, and not *Toxoplasma gondii*. Neosporosis

in the current case is thought to be due to reactivation of latent *N. caninum* occurring with the administration of glucocorticoid therapy. The severe complication in the present case highlights the importance of early detection and mitigation of common infections in immunosuppressed animals.

Newkirk KM, Hendrix DV, Anis EA, Rohrbach BW, Ehrhart EJ, Lyons JA, Kania SA. Detection of papillomavirus in equine periocular and penile squamous cell carcinoma. *J Vet Diagn Invest.* 2014 Jan;26(1):131-5. doi: 10.1177/1040638713511618.

In this study, VDL Pathologist E.J. Ehrhart helped re-examine 23 equine penile squamous cell carcinoma cases from three teaching hospital between 1996 and 2012, using PCR analysis to detect amplified DNA for papillomavirus. Their findings that 43 percent of the penile carcinomas yielded the viral DNA—demonstrating 99 percent homology to EcPV-2 E1 gene over 670—while none of the 42 periocular carcinomas did suggests the possibility for differing pathogeneses for the two entities. Although a combination of factors, including ultraviolet radiation, lack of pigmentation and papillomavirus, have been implicated in equine squamous cell carcinoma, their findings suggest squamous cell carcinomas have differing pathogeneses and, therefore, may respond differently to treatment.

Pepin KM, Spackman E, Brown JD, Pabilonia KL, Garber LP, et al. Using quantitative disease dynamics as a tool for guiding response to avian influenza in poultry in the United States of America. *Prev Vet Med.* 2014 Mar 1;113(4):376-397. doi: 10.1016/j.prevetmed.2013.11.011.

In this multi-institutional review, Kristy Pabilonia, VDL Avian Diagnostics and BSL3 Operations Section Head contributes to the discussion of where and how quantitative data could be employed to better predict and control an outbreak of avian flu should it infect the U.S. commercial poultry flock. Dynamic modeling, backed by standardized, rich data, could be useful in both prevention and response to any outbreak, including:

- Quantifying where and when wild bird hosts and poultry may interact and spread the virus.
- Understanding how the structure of the U.S. poultry industry might affect transmission.
- Quantifying the processes responsible for how avian flu might spread between poultry operations.
- Validating current policy-decision tools.



VDL Pathologist Chad Frank took part in a 2013 alpaca case study describing what the authors believe to be the first case reported in a camelid species of rhabdomyosarcoma, a soft-tissue sarcoma rarely encountered in veterinary medicine.

Source: Goncarovs-Gran KO, Frank CB, Baird AN, Couetil LL, Ramos-Vara JA. *Pathology in practice. J Am Vet Med Assoc.* 2013 Oct 15;243(8):1113-5. doi: 10.2460/javma.243.8.1113.



CSU VDL in the Field: Disease Updates

Looking for some Pre-Paid Feline Histology? We Have a Proposal for You

The Veterinary Diagnostic Lab has begun a cooperative project with the dentistry section of the teaching hospital to evaluate the presence of *Pasteurella multocida* serotypes A and B and their toxins in oral specimens of cats with chronic gingivostomatitis. The role of various viruses in this condition has been previously investigated, but little work has been done on bacteria. If *Pasteurella* and its toxins were found to play a role in this disease condition, there might be new therapeutic possibilities for affected cats.

To conduct this research, we need samples for microbiological and histologic evaluation from cats with gingivitis and caudal stomatitis. The cost of all the testing will be covered by the researchers. However, submissions must meet certain requirements to be eligible to participate in the project:

— Pat Cole, DVM, PhD, DACVP, CSU VDL Pathologist

- Cats need to be over 1 year of age
- They cannot have FIV or FeLV infection, renal disease, liver disease or other known systemic diseases that may affect the oral cavity.
- Cats would need to have had no antibiotics, no steroids and no immune-modulating drugs within the two weeks before samples are collected.
- Depomedrol (methylprednisolone) must be avoided for four weeks before sampling.
- Historical information will be needed from the submitting veterinarian and from the cat owner.
- Tissue for microbiology will need to be sent in special media that will be provided.
- Tissue for histopathology in formalin is also needed.

Think a case may be useful to this study?

Please contact:

■ Roxanne MacLellan
(970) 297-4178
Roxane.maclellan@colostate.edu

■ Patricia Cole
(970) 297-5127
Patricia.cole@colostate.edu.

FOR YOUR SAKE, AND OURS, DON'T NEGLECT HISTORY ON AMPUTATION SPECIMENS

When submitting amputation specimens, the Tissue Trimming Section encourages you to share information about the limb, including:

- Which limb is submitted?
- Where is the lesion within the limb?
- Are you interested in skin margins?
- Most importantly, are pins and plates remaining in the submitted limb? The trimming steps include using a band saw to permit bone viewing. If the band saw blade hits plates and pins, it is dangerous for both



the saw blade and our employees. Sharing this information allows us to process the limb in a safe and timely fashion.

Environmental Testing

Marine Mercury in Alaskan Wolves

In some areas of the Arctic, mercury concentrations in marine food-webs have increased to concentrations at which we may begin to expect adverse biological effects. Because we know grey wolves, although they feed primarily on ungulates, have also been found to subsidize their diets with marine organisms, using them in a study of cross-ecosystem food sources makes them an optimal species for studying mercury exposure in apex-predator wildlife populations.

Working with the Alaska Department of Fish and Game, we collected liver, kidney, skeletal muscle and cardiac muscle tissue subsamples from a total of 162 gray wolves between 2006 and 2009. Samples were then tested for total mercury concentrations as well as stable isotopic signatures. Stable isotopes, particularly of carbon-, nitrogen-, and sulfur-isotopic compositions, have been widely recognized as established proxies of the trophic architecture. Because marine organisms tend to have higher N-isotope signatures relative to terrestrial biota, N-stable isotopes have been used extensively to quantify marine-based dietary sources and distinguish them from terrestrial prey for a variety of mammalian consumers, including wolves, bears and mink.

Our wolf study found mercury concentrations varied widely among the four tissues, particularly for liver and kidney, and no significant differences were observed based on sex. However, median hepatic mercury concentrations were significantly higher in wolves with coastal access compared to wolves from the interior, and wolves that were 12 months old or older had

— Ashley K. McGrew, DVM, PhD, CSU VDL Postdoctoral Fellow; and Lora R. Ballweber, DVM, MS, CSU VDL Parasitology Section Head

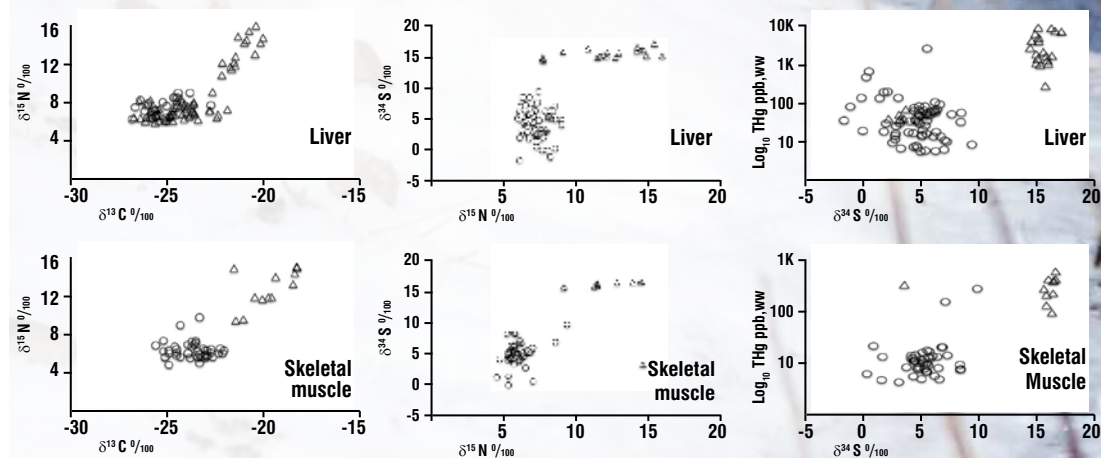
significantly higher hepatic and renal concentrations.

Median values for all stable isotopic compositions were found to be significantly higher in coastal animals for all tissues, suggesting a marine-based diet in coastal wolves. This work uniquely combined mercury concentrations and stable isotope signatures to better understand wolves' feeding ecology. The four separate measures support the contention that, when accessible, Alaskan gray wolves exploit marine resources, potentially putting them at risk for harmful effects associated with mercury exposure: reproductive impairment, alterations in growth and behavior, even death. Our integrated approach provides insight into how toxicant exposure relates to foraging ecology, opening the door to further evaluate the physiological, environmental, and social factors affecting diet variation to more clearly elucidate possible exposure pathways in individuals.

Stable isotope analysis confirms dietary exposure to marine-based mercury

The study's unique combination of total mercury concentrations and stable isotope analysis demonstrates the potential exposure of coastal grey wolves to mercury through their diet.

▲ Coastal wolves ● Interior wolves



McGrew AK, Ballweber LR, Moses SK, Stricker CA, Beckmen KB, et al. Mercury in gray wolves (*Canis lupus*) in Alaska: increased exposure through consumption of marine prey. *Sci Total Environ.* 2014 Jan 15;468-469:609-13. doi: 10.1016/j.scitotenv.2013.08.045.

Lab Updates

Fifty Years of Diagnostic Expertise

Wayne Hamar's educational journey began in a one-room schoolhouse in Central Nebraska where he had two other classmates, at the most. While his foray into academia had humble beginnings, he has made a dignified name for himself at Colorado State University as an associate professor in the College of Veterinary Medicine and Biomedical Sciences.

Hamar was first hired into the microbiology and pathology department and began doing research in the diagnostic lab where he still works today. His work with the Veterinary Diagnostic Lab used to take up only about eight to 10 hours of his time per week; he now supervises a few technicians, and the lab as a whole employs over 100 people.

Hamar obtained his undergraduate degree in chemistry from what was then known as Kearney State College, now University of Nebraska at Kearney. He grew up on a farm with four younger brothers and sisters.

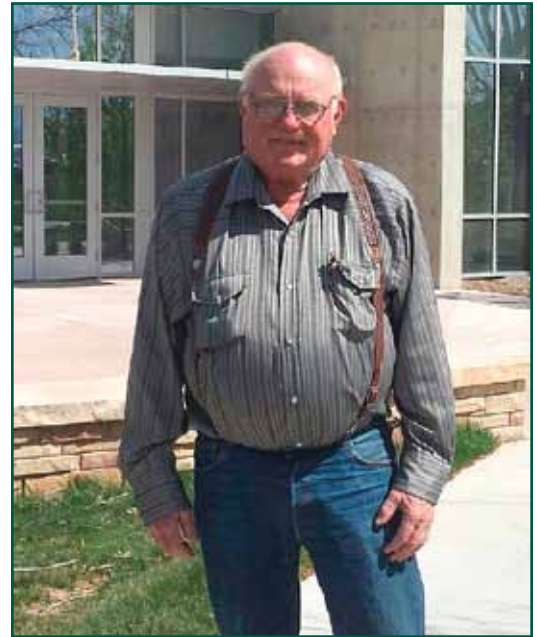
"Something that was unique about my education — we didn't have kindergarten," he recalls. "I started first grade when I was five. I was two months past 17 when I graduated from high school; two months past 21 when I graduated from college. So when your dad tells you when you get out of high school that 'if you're not in college by fall, you're on your own,' I don't think it gives you much choice but to go to college."

PROPENSITY FOR BIOCHEMISTRY

Hamar's natural propensity for chemistry paired with his interest in biology and livestock led him to the field of biochemistry. He obtained his master's and doctorate from the University of Nebraska, focusing specifically on the metabolism of ruminant animals.

Hamar's role with CSU evolved with advancements in the field of diagnostic medicine. Three years after he started working here in 1964, he was asked to teach biochemistry to veterinary students, because his education provided him with a good scientific base in physiology, bacteriology, basic chemistry and biochemistry.

He spent a year teaching biochemistry in Iran in the 1970s, but moved back once the possibility of a revolution became more of a reality. He also spent 12 years advising students in the College of Veterinary Medicine, an experience that he enjoyed because of the contact it gave him with students and faculty.



LOTS OF CHANGES

Nowadays, Hamar supervises the chemistry and toxicology lab and works as the quality manager for the entire diagnostic lab. He has seen a lot of changes, at the university and within the field.

"The College of Veterinary Medicine has been very progressive in terms of being a leader within the country in their approach to veterinary medicine and the requirements for admissions," Hamar said. "The types of students that are admitted and the kind of education they get has seen a lot of change. Part of that is just a change in society over that period of time."

Advances in the field of diagnostic medicine have led to an increase in specificity and precision. And while that also means veterinary medicine has gotten more expensive, as has human medicine, it brings about better diagnoses that serve both a scientific and pragmatic purpose.

FOUND HIS NICHE

In his 50 years with the University, Hamar has had many diverse roles and experiences. Having truly found his niche working in the diagnostic lab, he has been able to fully explore his strengths.

"It's important to understand that different people have different strengths," he said. "We made a decision in the department a few years back that the strength of the unit was a component of each individual; that each individual didn't need to have their strengths in the same place because then the whole department wasn't strong ... and so that's the way it is."

"It's been a fun ride," he said of his experience with the university which has been a definitive aspect throughout the course of his life.

Get to Know the Laboratory

New Members Join the Lab Team

Leigh Cooper joins the Veterinary Diagnostic Lab as lab support, working in both sample receiving and the virology lab. Originally from New Mexico, she came to Fort Collins to attend Colorado State and recently graduated with a bachelor of science degree in equine science. In her free time she enjoys volunteering at the Colorado Horse Rescue and hiking with her dog.



Tracy Toberman lived in eastern Colorado until age eight, when her family moved to the South. She attended East Carolina University and graduated with a degree in biology. After college, she moved to Charleston, S.C., and worked at a small-animal veterinary hospital, where she realized she wanted to make working in veterinary medicine her longterm career. In her spare time, she enjoys hiking, sports and spending time with her dogs.



David Rutherford, originally from Rochester, N.Y., got his bachelor of science degree in biotechnology from Syracuse's College of Environmental Science and Forestry. He moved to Colorado in September 2013 to be closer to his girlfriend, whom he now lives with along with their dog, Mishawaka. He enjoys hiking, camping, the great outdoors and classic rock.



Tom Davis was raised in Detroit but made several moves through Grand Rapids, Southern Ohio, Phoenix, Seattle and Hawaii. Starting as a technician in Michigan's health department, he returned to graduate school at Miami University in Ohio and then worked his way through several commercial and governmental labs to acting chief of the Arizona State Laboratory. Before coming to Fort Collins, where he now works in the Chemistry and Toxicology Section, he was half owner of a laboratory quality-assurance consulting



business which performed third-party quality assurance, training and lab audits for clients including the U.S. Navy and the University of Hawaii. He has no children but has two dogs that he treats like kids.

Kevin Daniels joins the lab in chemistry and toxicology support. Originally from Colorado Springs, he graduated from University of Colorado at Colorado Springs in May 2012 with a bachelor's degree in chemistry. He came to Fort Collins in November to work with the VDL and is excited at the opportunity to be involved with the impactful work done here. In his spare time, he reports he enjoys the great outdoors and being a terrible chef.



Danielle Goranson is the VDL office's newest administrative assistant. She grew up in Peetz, Colo., and earned her degree in political science from CSU. After graduation, Danielle pursued a career path in finance and customer service, but hungered for a more positive and intellectual environment. When not working, Danielle enjoys hiking, camping, dancing, traveling and general tomfoolery.



Seth Martinez, a Littleton native, is a senior undergraduate CSU microbiology student. Until he graduates and moves to nursing school to pursue a career as a registered nurse, he will be working in the VDL tissue-trimming lab. When not in school, he likes to explore new hiking trails and enjoys the Colorado wilderness, rock climbing and skiing.



Jason Williams joins the VDL as parasitology technician. Born and raised in Amelia County, Va., Jason moved to Colorado in 2006 to attend Colorado State, where he graduated in 2011 with a bachelor's degree in microbiology. His hobbies include hunting, fishing and spending time with his pugs.



CSU RESIDENT PARTICIPATION AND AWARDS AT ACVP

CSU residents were well represented at the 2013 Annual Concurrent Meeting of the American College of Veterinary Pathologists and the American Society for Veterinary Clinical Pathology, Nov. 16 to 20 in Montreal:

POSTERS

- **Seung Yoo: Modulation of coagulation and fibrinolysis by carbon monoxide and nitric oxide in dogs: a thromboelastographic analysis.**
- **Dan Regan: Losartan repurposed as novel monocyte migration inhibitor for treatment of cancer metastasis.**
- **Elijah Edmundson: Histopathologic characterization of catecholamine induced cardiomyopathy in dogs with pheochromocytomas.**

PRESENTATIONS

- **Deanna Dailey: Dog1 Is A Sensitive And Specific Immunohistochemical Marker For Diagnosis Of Canine Gastrointestinal Stromal Tumors (Gists)**
- **Elijah Edmundson: Characterization of the tumor spectrum in HZE ion irradiated outbred mice.**

■ Brendan Podell:

A Guinea Pig Model of Type 2 Diabetes as a Risk Factor for Tuberculosis.

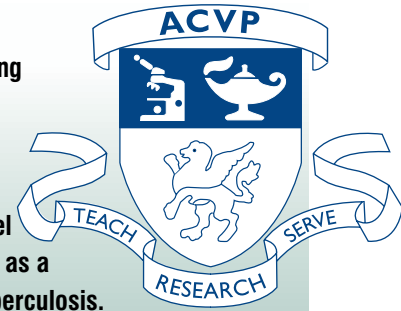
■ April White: Mystery cytology case:

Impression smear from an inguinal mass.

■ Seung Yoo: A horse of a different color.

AWARDS

- **Seung Yoo and Elijah Edmundson: Graduate Student/Resident ACVP Travel Awards.**
- **Seung Yoo: CL Davis Student Scholarship Award.**
- **Elijah Edmundson: ACVP Young Investigator Poster Competition Award, Experimental Disease and Industrial and Toxicologic Pathology category, second place.**
- **Chuck Halsey: ACVP Young Investigator Poster Competition Award, Experimental Disease and Industrial and Toxicologic Pathology category, first place.**



Guardians of Public Health

National Network Funding Update

The recent Farm Bill authorized up to \$15 million annually to fund the National Animal Health Laboratory Network (NAHLN). The state and federal partnership is of extreme importance to the nation's agriculture industry and food supply. NAHLN monitors for the potential incursion of foreign

animal disease like foot and mouth disease, performs surveillance testing for bovine spongiform encephalopathy, scrapie, chronic wasting disease, avian influenza and classical swine fever, as well as monitors for emerging new diseases such as the recently identified porcine epidemic diarrhea virus outbreak. NAHLN network labs have been providing USDA diagnostic data to better track this costly disease to determine where it came from, where it is spreading, and the best control practices.

Now that NAHLN has been reauthorized, funding must be appropriated. The House Agricultural Committee proposed total funding

— *Barbara Powers, DVM, PhD, DACVP,*
CSU VDL Director

of a little over \$11 million annually. Meanwhile, the Senate's version of the appropriation proposed a separate and distinct line item for the network. The appropriations request has yet to pass the full Senate and House floor to be finalized.

While still short of our final goal of \$30 million annually for the NAHLN, the funding is a step in the right direction. We thank our federal legislators and animal industry partners for their support. AAVLD will continue to work with Congress to develop funding levels to allow for NAHLN's full functionality.



Lab Updates

Faculty Achievement Recognized

CSU Veterinary Diagnostic Lab Director Barb Powers received the university's Oliver P. Pennock Distinguished Service Award in May. Paying tribute to a distinguished professor of civil engineering in the 1920s, the award recognizes faculty members who have made meritorious achievement over five or more years.

Powers was honored for advancing veterinary pathology through education, service and research since coming to CSU in 1981 as a PhD candidate and pathology resident and moving up to head the lab in 1997.

"She has been the driving force that resulted in the building of a new facility and a national reputation," said Gregg Dean, head of

the Department of Microbiology, Immunology, and Pathology. "She is a powerful advocate for animal diagnostics, Colorado agriculture and the veterinary community."

"It may be my name on the plaque," Powers says, "but this award recognizes the distinguished achievement our entire team and organization has made in the last 15 years. I am humbled to receive it on their behalf."

MASON MERITORIOUS TEACHER

Associate Professor of Microbiology, Immunology and Pathology Gary Mason received the 2014 Zoetis Distinguished Teaching Award May 15. Nominated and voted upon by veterinary students, the award honors faculty who have made outstanding achievement in teaching.



CSU VDL ON THE ROAD: UPCOMING CONFERENCES, SYMPOSIA AND APPEARANCES

Parasitology Section Head **Lora Ballweber** will attend the **American Association of Veterinary Parasitologists** annual meeting in Denver July 26 through 29. Look for her also at **Oklahoma State's Veterinary College Fall Conference**, Nov. 13 and 14 in Stillwater, and the National Animal Health Laboratory Network/American Association of Veterinary Laboratory Diagnosticians **Quality Management System Training**, Aug. 5 to 8 in Ames, Iowa. She will also attend the **Shelter Medicine Training Day**, Oct. 23 in Colorado Springs.

Come meet **Ballweber** along with VDL Director **Barb Powers**, Western Slope Lab Director **Don Kitchen**, Rocky Ford Lab Director **Gene Niles**, Pathologists **Tawfik Aboellail** and **Gary Mason**, Avian Diagnostics and BSL3 Operations Section Head **Kristy Pabilonia**, Chemistry and Toxicology Section Head **Dwayne Hamar**, Bacteriology Section Head **Doreene Hyatt** and Virology Section Head **Hana Van Campen** at this year's 57th annual meeting of the **American Association of Veterinary Laboratory Diagnosticians**, Oct. 16 through 22, in Kansas City.

Pabilonia will also be at the **National Poultry Improvement Plan Biennial Conference**, July 10 to 12 in Charlotte.

Niles, **Ballweber** and **Pabilonia** will be at the fall meeting of the **Colorado Veterinary Medical Association**, Sept. 18 to 21 in Loveland, as will **Van Campen**, who will be helping with the Ag

Animal section of CVMA Fall meeting Sept 18-21.

Kristy Pabilonia will attend the annual meeting of the **American Veterinary Medical Association**, July 26 through 29 in Denver, along with **Hana Van Campen**, who will be volunteering there. VDL Pathologist **Gary Mason** will also be there, speaking during the small-ruminant sessions.

VDL Pathologist **E.J. Ehrhart** will be at the second annual **Comparative Ocular Pathology Society** annual meeting, Sept. 17 through 19 in Colorado Springs.

VDL Pathologist **Colleen Duncan** travels to Alaska in July to capture and tag sea lions, where she will also work with VDL Pathologist **Terry Spraker** on a fur-seal study. He also plans to attend the **Marine Mammals of the Holarctic Conference** in St. Petersburg, Russia, in September and the **Alaska Marine Science Symposium** in January in Anchorage.

Van Campen will be attending the **American Association of Veterinary Laboratory Diagnosticians** Executive Board Meeting in Denver on July 31.

Rocky Ford Lab Director **Niles** will be at the **Academy of Veterinary Consultants** meeting in Denver, July 31 to Aug. 2.

Look for Lab Coordinator **Charlie Davis** at the **Colorado Wool Growers Association** convention July 16 and 17 in Montrose, Colo.

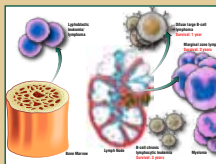
REGULAR COLUMNS

- **CASE STUDY** p. 6
Ewe sodium intoxication.
- **VDL IN PRESS** p. 9
New research round-up.
- **DISEASE UPDATES** p. 10
Have a cat gingivitis case?
- **LAB UPDATE** p. 13
Meet new staff members.
- **LAB UPDATE** p. 15
Faculty achievements.

LAB LINES

INSIDE THIS ISSUE

- PRODUCTION MEDICINE . . . p. 1**
New field investigation unit puts multidisciplinary medicine to work.
- CANINE ONCOLOGY p. 2**
It's time to re-examine how we divide lympho-proliferative disorders. Here's why.
- TOXICOLOGY p. 4**
Low-quality forages spell increased nitrate toxicity.



- EXOTICS MEDICINE p. 8**
VDL faculty report on a novel case of *Rickettsia* in a scorpion.
- ENVIRONMENT p. 11**
Arctic wolf study puts new perspective on mercury risk.
- LAB UPDATES p. 12**
For a half century, VDL's Dwayne Hamar has been involved in many diverse roles with CSU's VDL.



Update from the Director

In this issue of *LabLines*, we highlight the new Field Investigation Unit that was introduced early in 2014. This unit is off to a vigorous start, with multiple investigations already concluded or ongoing.

Inside you will also find many articles on a variety of issues affecting multiple species, new discoveries, and interesting cases. In addition, there is an opportunity to participate in a new study. We introduce many new staff members who have started over the last six months as well as honoring Dr. Dwayne Hamar for his 50 Years of Service at Colorado State University, mostly within our laboratories. Our pathology residents and faculty have received numerous awards this year as well. See inside for details!



BARBARA POWERS, DVM, PHD, DACVP DIRECTOR

maries and a wealth of diagnostic results summaries that give a unique insight in to the health situation of Colorado's animal population. The entire report is available on our web site, under the Regulations and Resources tab. A limited hard copies are also available; call us if you have comments or wish to receive a hard copy.

In January, we met with our External Advisory Committee, as we do annually, and reviewed our new five-year strategic plan. There are many new internal and external goals within this plan; many of these are already well underway, or are even completed. Also This September, we will be holding the president's reception of the annual Colorado Veterinary Medical Association Convention in the Diagnostic Medicine Center and look forward to an interactive reception with many of you. Later in October, we hope to see many of you at the American Association of Veterinary Laboratory Diagnosticians annual meeting in Missouri.

Best wishes,

Barbara E. Powers

Barbara E. Powers, DVM, PhD, DACVP, Director



We have just released our Annual Report for the year 2013. Inside you'll find more than 60 pages highlighted the annual achievements of the diagnostic lab system, from scientific papers published by faculty to funded and ongoing investigations we're undertaking, to accession sum-