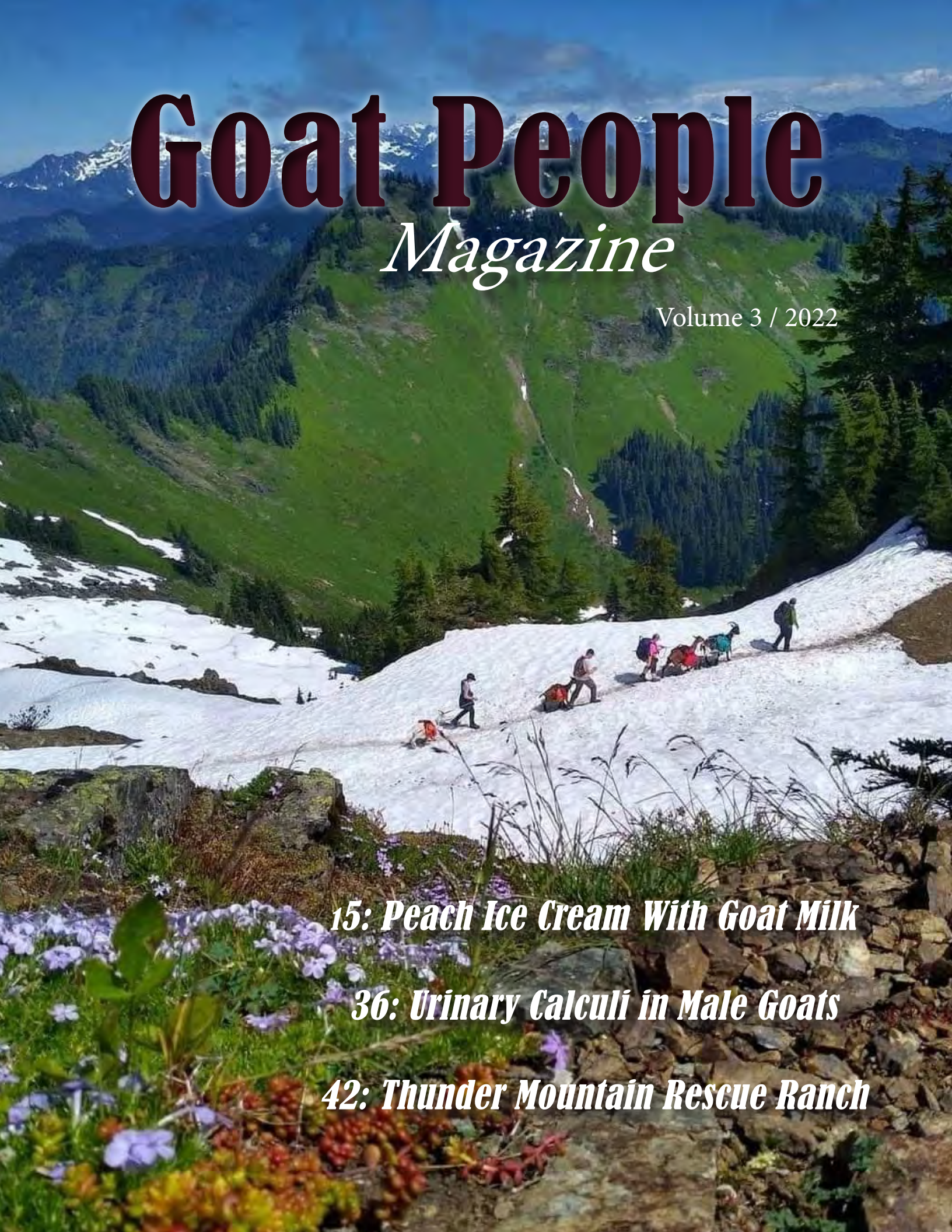

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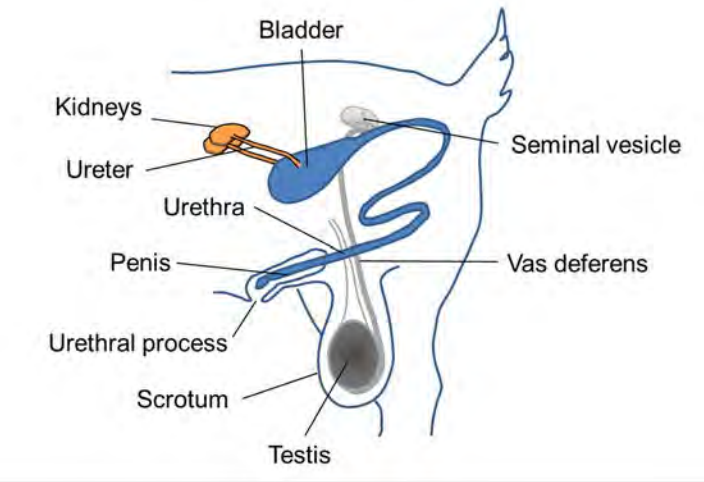
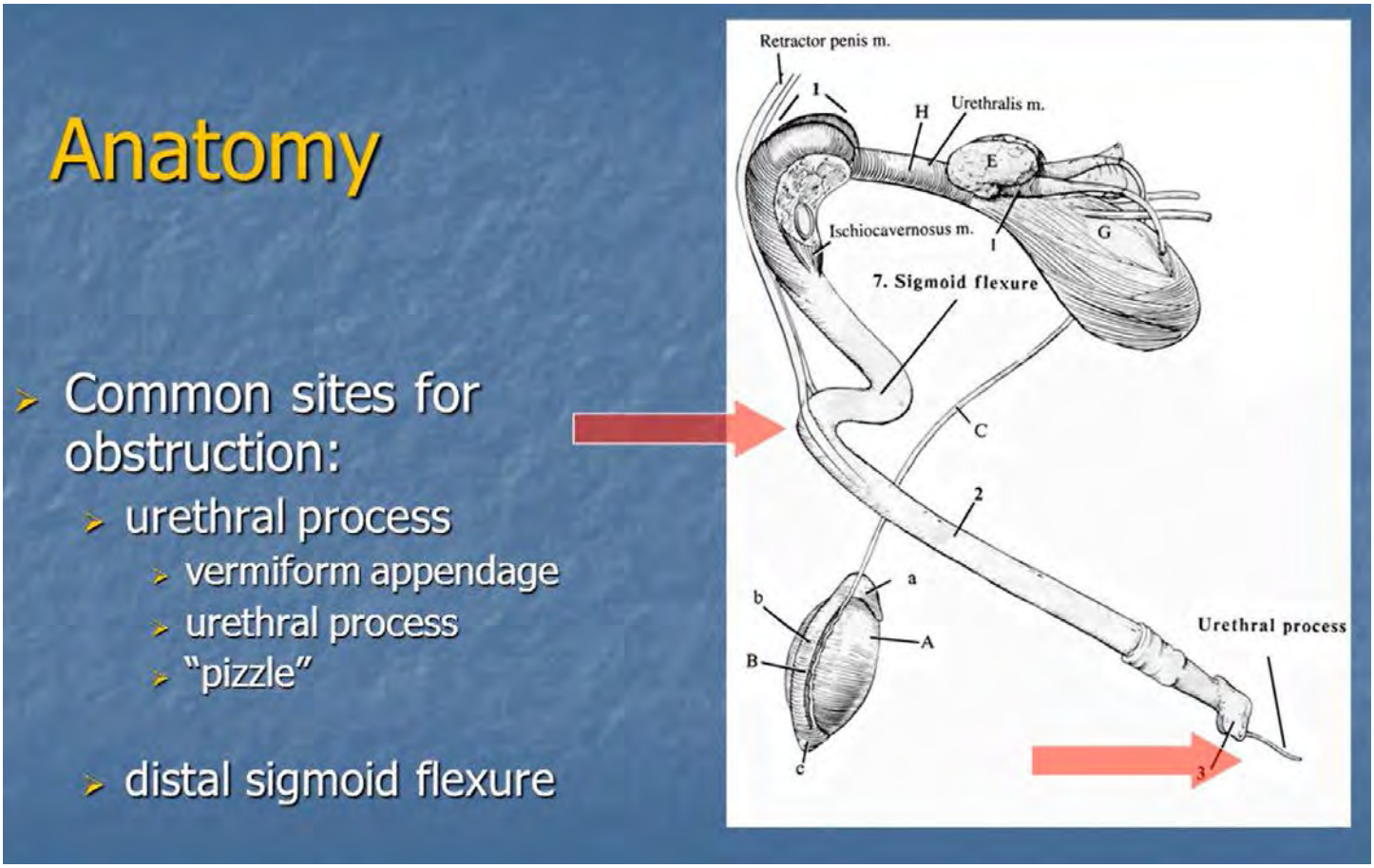
Urinary Calculi (UC) in Male Goats
by Taffy Mercer and Chris Gifford

Urinary Calculi (UC) – two words no goat owner wants to hear as a diagnosis for one of their goats.

As far too many goat owners have learned through painful personal experience, UC is an all too frequent cause of mortality in wethered goats. With urinary calculi, uroliths (also known as calculi or "stones") develop in the bladder and can lodge anywhere in the urinary tract causing an obstruction. When a "stone" blocks the urethra, urine can no longer be expelled from the body which causes it to back up in the goat's system. This is a very painful condition. Without intervention the bladder will rupture and the goat will die.

The medical terms for urinary calculi are urolithiasis (when uroliths are present) or obstructive urolithiasis (when uroliths create a blockage). Male goats suffer from the effects of urinary calculi more frequently than females due to their anatomy. Unlike female goats, males have a long urethra with an "s" shaped curve, known as the sigmoid flexure, where uroliths often





become lodged. In addition, male goats have a 2-4-centimeter-long structure at the end of the penis called the urethral process (or vermiform appendage), which is very small in diameter making it very susceptible to blockage by urinary calculi.

There are two preventative measures that can be taken to make the urinary tract less likely to become blocked: (1) delaying castration until puberty (4-6 months of age) in order to allow the urethra to more fully develop and increase in diameter and (2) prophylactically removing the urethral process. Delaying castration has been shown to have a positive impact on urethral diameter in calves and lambs, providing more room for any uroliths that may form to pass through the urethra. The purpose of the urethral process is to direct the flow of semen during copulation; however this appendage is not necessary for bucks to successfully breed.

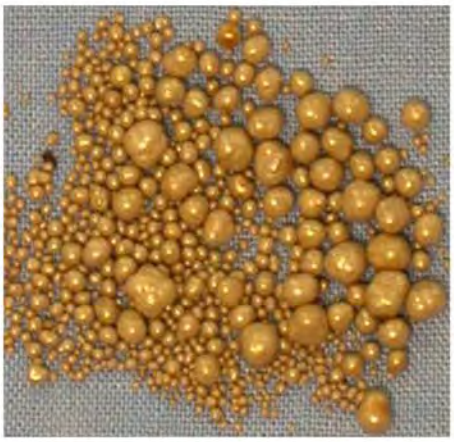
Prophylactic removal of the urethral process eliminates the site where obstruction occurs in approximately 50% of obstructive urolithiasis cases.

Urolithiasis is a multifactorial disease, which makes efforts to develop and implement prevention strategies very challenging.

It is widely accepted by veterinarians, animal nutritionists, and scientists that the mineral content of a goat's diet (both hay/forage and water), amount of water intake, and mineral supplements are major contributing factors in the development of this disease in small ruminants.

Several other factors such as a goat's general health, individual metabolism, parasite management, weight management, the age or method of castration (resulting in greater urethral diameter), and the total hardness (CaCo3) of a goat's water source also may contribute to the prevalence of obstructive urolithiasis. If a goat does develop obstructive urolithiasis, early recognition and treatment are critical to successful treatment and survival of the affected goat.

Calcium Oxalate Uroliths



Calcium Carbonate Uroliths

Silicate Uroliths

Phosphatic Uroliths

Signs and Symptoms:

- Restlessness, getting up and down.
- Pawing the ground.
- Looking at abdomen.
- Posturing repeatedly to urinate. The tail may

be seen to "pump" up and down and the goat's side can be seen to heave as the animal strains to void urine.

- Stomping of the rear feet (or kicking at the belly) or walking backwards.
- Vocalizations of pain and discomfort.
- Final stages: grinding of teeth

There are four main stone types:

- phosphatic (including struvite, apatite, and amorphous magnesium calcium phosphate)
- calcium carbonate
- silicate
- calcium oxalate

Phosphatic stones occur in sand-like form or are easily crushable, while calcium carbonate uroliths are gold beads with a very stable structure. Both phosphatic and calcium carbonate stone types form in alkaline urine and in animals on high grain or legume diets. Urine pH likely has no impact on the formation of silicate or calcium oxalate uroliths; these form in animals grazing siliceous pastures (pastures with grasses and soil high in silica) in the western USA and Canada or those grazing oxalate-containing plants, respectively.

Among the surgical techniques described for relief of urinary obstruction in male goats are:

- Vermiform appendage (urethral process) amputation. There are almost always more uroliths, however, and these relieved animals are at high risk of re-obstruction.
- Tube cystotomy. This procedure is considered the gold standard treatment for cases of urethral obstruction because it provides an alternate route for urine flow while allowing healing of the urethra. Tube cystotomy is associated with a higher cost than other surgeries for obstruction but has been reported to have 76%–90% short-term success at reestablishing urethral urine flow, with an 86% l ong-term success rate.
- Urinary bladder marsupialization. A permanent or semi-permanent stoma from the urinary bladder to the skin is created providing urine outflow that bypasses the urethra. This procedure is associated with complications of urine scald, mucosal prolapse, and ascending urinary tract infections.
- Perineal urethrostomy. Urination is established via a stoma created with the proximal urethra. This procedure is associated with a high risk of stricture.

The reported outcome is that 45%–78% will stricture within 8 months, making this generally an undesirable option for most goats.

Increasing urine volume and dilution can be achieved by increasing water intake by providing clean, palatable, temperature-appropriate water and adding NaCl (salt) to the diet. Encouraging grazing and feeding a high-forage diet with limited grain and pelletized feeds also increases water intake. A high-roughage diet requires more water for mastication and

digestion, therefore increasing urine output over that of concentrate diets.

Show goats and feeder animals are at most risk for phosphatic stones. Goats consuming alfalfa and other legumes are at highest risk for calcium carbonate stones. Both of these stone classes form in alkaline urine. Urinary acidification can be achieved with oral administration of ammonium chloride in the short term.

Long-term continuous ammonium chloride treatment is ineffective due to a presumed physiological response returning the urine pH toward alkaline. Pulse dosing regimens have been employed to counteract this proposed effect. Animals on ammonium chloride

should have their urine pH evaluated periodically 5–7 hours after feeding to determine whether adequate acidification is occurring, with the dosage adjusted for the individual.

Silicate and calcium oxalate uroliths are associated with specific plants on pasture. Some plants store high quantities of potassium and sodium oxalates (salts).

If large quantities of oxalate accumulating plants are eaten, the rumen is overwhelmed and unable to metabolize the salts and they are absorbed into the bloodstream. In the bloodstream they form insoluble salts that precipitate in the kidney, causing kidney failure. Examples of these plants are: Amaranthus retroflexus (Redroot pigweed), Chenopodium album (Lambsquarter); Malva neglecta (Common mallow); Rumex spp. (Dock).

The calcium:phosphorus (Ca:P) ratio should be maintained between 1:1 and 2:1, preferably 1.2–1.5:1 in goats because of their predisposition for urinary calculi.

If you are feeding grain or pelletized feed, the Ca:P ratio of the total ration should be held at 2–2.5:1 to limit phosphorus availability for phosphatic uroliths. An increase in this ratio predisposes to calcium carbonate uroliths, whereas a reduction predisposes to phosphatic uroliths.

A thorough review of the diet and management of herds should be performed, especially in herds with cases of urolithiasis. It is extremely important to know what the Ca:P ratio is for everything your goat consumes. Hay, forage, and water should be tested. Mineral labels will have the calcium and phosphorus content listed. Treats and anything else they eat or drink should also be taken into consideration when combining all calcium and phosphorus content to determine the total Ca:P ratio your goats are consuming.

A Citizen Science Epidemiological Research Study of Urinary Calculi in Wethered Goats, spearheaded by The North American Packgoat Association (NAPgA), began on June 1, 2022. NAPgA has partnered with over 69 of its members and enrolled over 400 wethered goats in the research study.

The objective of this study is to identify possible effects of diet, water, minerals, body condition, age and method of castration, animal husbandry, geographic and environmental factors associated with the development of urinary calculi in wethered goats and related optimal standards for the prevention of urinary calculi. It is expected that the study will benefit owners from all user groups including dairy, fiber, meat, show, 4-H, special purpose (brush control and packgoats), and pets and all breeds of goats.

NAPgA will be working with two Co-Investigators who will analyze the research data and author a written report which is intended for publication and peer review.

Co-Investigator, Dr. Meera Heller, DVM, PhD, DACVIM, is an Associate Professor of Clinical Livestock Medicine at the School of Veterinary Medicine at University of California Davis. Dr. Heller assisted with project design for this study and she will work with NAPgA's Urinary Calculi Research Committee and her colleagues in veterinary medicine to assist with analysis of the data collected and other components to complete the study.

Co-Investigator and NAPgA Urinary Calculi Research Committee Member, Margaret (Maggie) Highland, DVM, PhD, DACVP, is the Pathology Section Head at the Wisconsin State Veterinary Diagnostic Laboratory. Dr. Highland will use the data obtained from surveys and urinary tracts recovered from wethered goats that die during this study to further research the effects of the age and method of castration on urethral diameter in wethered goats.

In addition, Dr. Highland will bank blood and/or tissue samples received from goats enrolled in the study as a source of DNA for possible future genotyping research related to urinary calculi and will also submit any uroliths recovered from enrolled goats to the Minnesota Urolith Center for composition analysis.

NAPgA allocated funds from a dedicated research fund ("The Carolyn Eddy Research Fund") established by one of its founding members, the late Carolyn Eddy, to begin this long-term study. NAPgA has received nearly $20,000 in additional generous donations from private donors that are earmarked

specifically for this study. Additional funding to complete the three-year study is needed and NAPgA is soliciting private and corporate donations, grants, and other outside financial assistance to fund this study. If you are interested in learning more about this study please visit NAPgA's website (napga.org) and click on the Urinary Calculi Research Study under the "About Us" tab or this link https://www.napga.org/urinary-calculi-research-study/

References:

Merck Veterinary Manual
https://www.merckvetmanual.com/urinary-system/noninfectious-diseases-of-the-urinary-system-in-large-animals/urolithiasis-in-ruminants

Oregon State University Extension Service
https://extension.oregonstate.edu/gallery/plants-causing-nitrate-oxalate-poisoning-pastures

Food Animal Urology M.S. Gill, DVM, M.S. ppt. presentation
https://slideplayer.com/slide/9410572/

Langston University American Institute for Goat Research
http://www.luresext.edu/?q=content/urinary-tract-disease

Texas A&M University
https://www.tamu.edu/search/index.html?q=urolithiasis+in+goats

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