

NORTH CAROLINA ZOO

VETERINARY REPORT



A NOTE FROM PAT

Hello Everyone,

Have you ever been fascinated by a doctor's office? I am always amazed by the tools, machines, gadgets, and all those people with specialized knowledge buzzing about, asking questions, and trying to figure out how to help others feel better.

If you think a human doctor's office is interesting, you should see the medical setup of people who work with animals! From teeny tiny frogs to giant elephants, these experts work to keep everyone healthy and comfortable without the benefit of being able to ask their patients questions.

Our Animal Health Team at the North Carolina Zoo takes its charge of keeping all our residents comfortable and healthy extremely seriously. We all do. We want our animals to thrive, which means regular preventative examinations, emergency care, or pre-planned surgeries such as dental work or hysterectomies. Our veterinarians and their support teams treat the animal holistically, looking at their ailment, habitat, food intake, playtime, natural behaviors, and interaction with others, both human and animal. The animal health experts are highly educated, skilled, and fascinating to be around.

But our Animal Health Team goes so much further. In addition to being up to date with the most recent knowledge, they actively contribute by publishing research papers and being actively involved with in-situ conservation efforts and teaching. The team



is involved with education from the tender years of middle school through veterinary resident training! All our veterinarians are Board Certified in Zoological Medicine, meaning they have reached a significantly higher level of training that allows them to not only be top of their game but also be able to teach other professionals.

The world of veterinary care is amazing, and the people—who dedicate themselves to acting on behalf of those who have no voice—are champions. Our thriving, healthy animal residents are a testament to their great work.

We hope you enjoy the content presented in this publication and come to see the animals we know so well.

Sincerely,
Pat Simmons | North Carolina Zoo Director & CEO





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A DAY IN THE LIFE

GENERAL PRACTICE

Every animal at the North Carolina Zoo (Zoo), big and small, receives care from their dedicated family doctors in the Animal Health Section. The Animal Health Section, encompassing the Veterinary and Wildlife Rehabilitation Center (WRC) Teams, consists of veterinarians, veterinary technicians, wildlife rehabilitators, and hospital keepers. Each team member has specialized expertise to handle any medical need in any species, from fish to rhinos. Whether conducting routine checkups or performing emergency surgery, we are equipped to manage a wide range of tasks. You might find us cleaning a baboon's teeth, trimming an oryx's hoof, performing a sonogram on a pregnant sand cat, or providing acupuncture on a snake with arthritis. We are here to ensure the well-being of every creature in the Zoo's care from head to toe!

PREVENTATIVE MEDICINE & NUTRITION

In the Animal Health Section, we take on multiple roles and work closely to ensure animals stay healthy. Our comprehensive preventative medicine program takes a 360° approach to prevent disease and promote well-being. Each animal living at the Zoo receives routine checkups, teeth cleaning (if they have them!), regular blood work, and diagnostics. We also provide guidance on a complete and balanced diet tailored to each species, whether they eat salad, meat, or even bugs. We carefully assess enrichment items such as treats, plants, and toys to ensure they enhance animals' lives without posing health risks or causing injuries. Additionally, we partner with animal care staff to train animals to participate in



their own medical care and bring positivity to their checkups. The Veterinary Team is also responsible for quarantining new or sick animals, conducting health tests for animals arriving at or leaving the Zoo, and developing disease monitoring and prevention policies for the Zoo's residents.

REPRODUCTION PLANNING & MANAGEMENT

Did you know that zoos worldwide use matchmakers? The North Carolina Zoo is accredited by the Association of Zoos and Aquariums (AZA) and participates in several AZA Saving Animals From Extinction (SAFE) programs. The mission of this program is to conserve species through responsible breeding and maintain the genetic integrity of animals in the Zoo's care. When the SAFE program identifies a suitable match, the Zoo does its best to foster that connection. The Veterinary Team plays a crucial role in this process by assessing potential parents' reproductive health and viability, monitoring the health and development of pregnant moms, and assisting with births when necessary. When babies are born, we perform neonatal exams and ensure that dependent babies have bonded with their moms. Then, we continue checkups and vaccines to support each young animal's growth and health. If an individual is genetically valuable but not yet ready for parenting, we can provide contraception or collect biological samples for future use in advanced reproductive techniques.



EMERGENCY MEDICINE

When an animal needs help, the Veterinary Team must be prepared to respond to any possible situation. We are trained and ready for any emergency, from wound care to cardiopulmonary arrest. Furthermore, an animal experiencing an emergency may be unable to come to the hospital, so our team is equipped and prepared to treat animals anywhere in the Zoo, rain or shine. We must also be prepared to treat animals that pose logistical challenges, like dangerous animals (ever placed a breathing tube in a venomous rattlesnake?) and animals that are hard-wired to hide their injuries. When an emergency arises, we mobilize our full range of resources, including anesthesia, radiographs, blood work, wound care, or whatever that animal needs to get back on its feet.



GERIATRIC & END OF LIFE CARE

Loving an animal means experiencing both the joys and challenges of watching them age. The Animal Health Team takes immense pride in ensuring that the animals in our care can live full, healthy lives. As they grow older, we do everything we can to keep animals comfortable, addressing issues like sore joints and worn-down teeth. Though some days are more challenging than others, we are committed to providing Whole Life care for every animal at



the North Carolina Zoo. Each one deserves our unwavering care and compassion throughout their entire life journey.

WILDLIFE REHABILITATION

Every day at the North Carolina Zoo's Wildlife Rehabilitation Center (WRC) brings something new. Through newly admitted patients and successful releases, the WRC's caseload can vary significantly from day to day, totaling around 500-700 patients annually and representing over 100 species. On any given day, you might see a variety of songbirds being fed in the Avian Nursery or a passel of orphaned opossums in the Mammal Nursery. In the Veterinary Ward, which handles intensive and dangerous cases, team members will be caring for sick turtles with aural abscesses or perhaps an orphaned North American River Otter receiving treatment for pneumonia. As each animal is admitted, WRC staff, volunteers, and interns conduct immediate triage and provide stabilizing measures. Then, one of the North Carolina Zoo's veterinarians performs a thorough physical exam, carries out diagnostic testing, and develops a treatment plan to ensure the animal's full recovery and eventual release back into the wild.

“Every animal at the North Carolina Zoo, big and small, receives care from their dedicated family doctors in the Animal Health Section.”

MEET OUR TEAM



JB MINTER

Director of Animal Health



HEATHER SCOTT

Hospital Manager



HALLEY BUCKANOFF

Wildlife Rehabilitation
Center Supervisor



TIM GEOROFF

Associate Veterinarian



MEGAN CABOT

Associate Veterinarian



AMY KOEPP

Hospital Registrar



KELLY TARDIF

Registered Veterinary
Technician



SAM KNOWLES

Registered Veterinary
Technician



ALLY LINDSTROM

Registered Veterinary
Technician



NICOLE HAYNES

Registered Veterinary
Technician



WENDY HOLM

Registered Veterinary
Technician



BROOKS LONG

Wildlife Rehabilitation
Center Staff



EMMA COOK

Wildlife Rehabilitation
Center Staff



JAMIE SINK

Wildlife Rehabilitation
Center Staff



SKYLER WESENDUNK

Wildlife Rehabilitation
Center Staff



AMANDA HARVILLE

Hospital Keeper



LINDSAY LONG

Hospital Keeper



GRACE HARVEY

Hospital Keeper

OUR YEAR IN REVIEW

3218

APPOINTMENTS

1895 MAMMALS

496 REPTILES

422 BIRDS

364 AMPHIBIANS

35 FISH

6 INVERTEBRATES

3331 DIAGNOSTIC
TESTS RUN

1790 PRESCRIPTIONS
FILLED

176 ANESTHESIA
PROCEDURES

147 VACCINES
ADMINISTERED

391 WILDLIFE CENTER INTAKES





MEDICAL CASE HIGHLIGHTS

VETERINARY MEDICINE IN ACTION

When people discover we work in the Animal Health Section of the North Carolina Zoo, they often ask, "What does an average day look like for you?" The answer: No two days look the same, and that is the way we like it.

Our team is dynamic, flexible, adaptable, brave, adventurous, resilient, and absurdly smart. We take on every patient and any challenge that comes our way.

With boundless compassion for every creature, no matter how small, we dedicate every moment to providing exceptional care for all our patients. To give you a glimpse into our world, we have compiled some of our wildest cases of 2022–2023.



WHEN EVERY DROP COUNTS

Nick Dannemiller

In the fall of 2022, a big animal at the North Carolina Zoo had a big problem: Natalie, a 30-year-old female southern white rhino, was severely anemic. Her condition quickly led to extreme lethargy and weakness, and she became too tired to move her 3,000+ pound body. The Veterinary Team needed to stabilize Natalie while we investigated the root cause of her anemia. With no time to lose, we mobilized to provide Natalie with a blood transfusion. A blood donation was obtained from another southern white rhino within the Zoo's crash. The blood was tested for compatibility, and 4 liters were administered to Natalie the same day. This was the first blood transfusion performed in a rhino in the Zoo's 50-year history. The task required coordination from staff across the organization. Although Natalie's blood transfusion was successful in the short term, she was later diagnosed with terminal metastatic T-cell lymphoma, leading to her euthanasia. Despite the challenging outcome, Natalie's case demonstrated the Veterinary Team's ability to deliver critical care regardless of the animal's size.





CASTING A KUDU

Lauren Mumm

Chanel was only four days old when she was seen limping on her right front leg. Radiographs revealed a fracture in her lower leg. Luckily, the bones were well aligned. A cast was applied on her leg, and she was hospitalized in the barn with her mom, Hubble, allowing her to rest, heal, and continue nursing. As Chanel was young and growing quickly, her cast was changed weekly to prevent limb deformities and ensure proper growth. After 4 weeks, follow-up radiographs confirmed her fracture was healed! With her cast removed, Chanel and her mom were successfully reintroduced to the herd. Today, Chanel is doing great and can be found running the grasslands habitat with the other young kudu.



THE SMALL AND MIGHTY

Lauren Mumm

One morning in the Desert Dome, a giant horned lizard was discovered to have a large open wound across his back. It was suspected that the injury might have been caused by a mischievous cricket the lizard had not eaten the night before. When the lizard arrived at the hospital, his eyes were closed, and his body posture was tense. He was sedated for wound debridement and cleaning, then hospitalized for a few days for more intensive wound care. He was treated with pain medications, antibiotics, and “super-hero” hydrocolloid bandages designed for optimal healing. After three weeks, his skin had healed, and scar tissue started to form. Reptiles are known for their resilience, and this lizard certainly upheld the reputation.



NOT JUST CATS AND DOGS

Megan Cabot

Keepers noted an adult female Madagascar hissing cockroach to be lethargic and not eating. They reported that her abdominal area was distended, and on veterinary examination, it appeared she was straining to pass her egg sac (ootheca). The Veterinary Team jumped into action to help her! She was anesthetized with gas anesthesia, and a small endoscope was inserted into her genital pore

to visualize the retained ootheca, which appeared to have adhered to the wall of the brood sac. The ootheca and brood sac were gently retracted out of the genital pore, and surgery was performed to remove the brood sac, effectively spaying the cockroach. Fortunately, she has a second genital pore on her other side, which could still be used to make eggs.



JUST KEEP SWIMMING

Nick Dannemiller

The North Carolina Zoo's Streamside habitat showcases the diversity of a Carolina stream and features native game fish in an immersive 25,000-gallon freshwater aquarium. When an endangered shortnose sturgeon in the aquarium began exhibiting abnormal swimming patterns and stopped eating, the Zoo's Animal Health Team took a deep dive to diagnose the issue.

Alongside a thorough examination, blood work, and imaging, the team performed additional diagnostics, including water quality testing, a unique but essential part of aquatic animal medicine. Both blood work and aquarium substrate samples showed elevated levels of heavy metals, which could potentially cause the sturgeon's abnormal behavior. It was suspected that these elevated levels resulted from heavy metals leeching from the scaffolding behind the artificial rock in the aquarium, demonstrating the importance of considering an animal's environment when assessing their health. The Zoo has since taken steps to remove the hazardous substrate. Now, life for the sturgeon and the aquarium's other residents is going swimmingly.



AN UNBEARABLY CUTE ENDEAVOR

Emma Cook

Every Spring, the Wildlife Rehabilitation Center (WRC) at the North Carolina Zoo becomes home to some rough and tumble bundles of joy: baby black bears! These bear cubs arrive after being orphaned, injured, or found sick in the wild, often losing their mothers to human-wildlife conflict. To give these cubs the best chance at a successful return to the wild, the WRC has teamed up with the North Carolina Wildlife Resources Commission (NCWRC) for their care and rehabilitation. Each cub receives a thorough health assessment, and any injuries or illnesses are treated. They are first bottle-fed, if needed, and gradually transitioned off milk at the proper age. Once they are weaned, they spend the following months in a hands-off environment with other cubs, where they learn essential bear skills like climbing and foraging. At the end of the summer, they undergo another full exam and receive individual identification such as microchips, ear tags, and GPS collars for continued monitoring by the NCWRC. Then, when they are grown and ready, they are released back into the wild!



IN THE WINK OF AN EYE

Megan Cabot

The Zoo's beloved harbor seal, Ronan, developed inflammation in his eye that eventually led to scarring and glaucoma, a condition characterized by elevated pressure within the eye. Despite numerous treatments and medications, the affected eye was causing him significant pain and loss of vision. After careful consideration, it was decided to remove the eye. A team of experts was assembled, including a veterinary ophthalmologist and anesthesiologist. The team performed surgery to remove the eye, which was then sutured closed, leaving Ronan with a permanent wink. Ronan's surgery site healed completely, and he is now safely back in the water.



OPERATION HELLBENDER

Megan Cabot

The eastern hellbender is the largest salamander in North America and a native of North Carolina. They are fully aquatic, living in the rocks at the bottom of fast-flowing rivers and streams and breathing primarily through their skin. At the North Carolina Zoo, one hellbender was observed occasionally floating upside down or with its hind end elevated in the water. During its veterinary examination, radiographs revealed a large stone in the colon that the hellbender must have eaten but was unable to pass. To pinpoint the stone's location, we introduced contrast material into the stomach via a tube. Then, we monitored radiographs over the next two days as the contrast moved down to the colon and surrounded the stone.

We attempted to remove the stone with a minimally invasive colonoscopy, and although we could grasp the stone, it was too large to pass through the opening at the end of the colon for removal. Consequently, we performed surgery, opening the abdomen and colon under anesthesia. Since hellbenders live underwater and breathe through their skin, anesthetic drugs are placed in the water and bathed over the hellbender, rather than gas anesthesia that would be administered through a breathing tube. The surgery was successful, and the hellbender has since recovered well, appearing much more comfortable and showing no further issues with floating.





SNAKE IN THE ROUGH

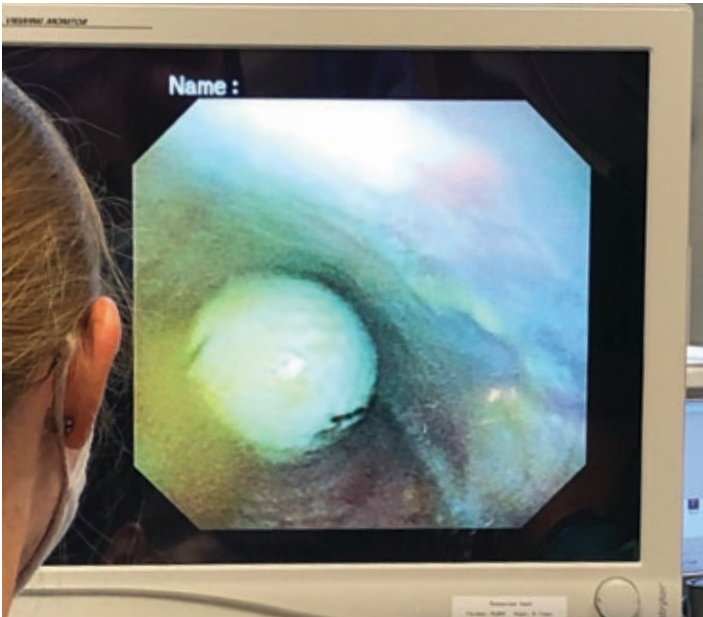
Megan Cabot

An adult black rat snake was brought to the Wildlife Rehabilitation Center (WRC) at the North Carolina Zoo after infiltrating a chicken coop and being found with a large lump in its body. On a radiograph, the WRC Team found a large, round, solid object in the snake's stomach and knew right away what had happened. Golf balls or wooden eggs are often put in chicken coops to encourage chickens to lay eggs in nest boxes or to give a broody hen something to sit on.

Snakes are unable to differentiate the decoy eggs from the real ones and will often eat both. However, these decoy eggs do not break down and often get stuck in the snake's stomach. Luckily, the Veterinary Team was on the case! The snake was fully anesthetized and supported with a breathing tube. An endoscope, with a camera and a wire net on the end, was placed into the mouth and fed down into the stomach to visualize and capture the golf ball in the net. This allowed the golf ball to be pulled back out slowly through the mouth and removed.

In the care of the WRC Team, the snake recovered well and was later released back into the wild! The Zoo encourages anyone using false eggs in their chicken coop to glue the decoys together in the shape of a pyramid, as this helps to prevent snakes from ingesting these foreign objects.

“Snakes are unable to differentiate the decoy eggs from the real ones and will often eat both.”





MEDICAL BEHAVIOR TRAINING

Animal welfare is a top priority at the North Carolina Zoo. An essential part of prioritizing welfare is maintaining a robust medical behavioral training program through close collaboration between the Veterinary Team and animal care staff. Historically, if an animal was too large or dangerous to provide basic veterinary care, we relied on anesthesia, often administered via a dart gun, even for things as simple as collecting blood or giving vaccinations. Not only can darting be stressful for an animal, but anesthesia comes with inherent risk. While darting remains a valuable tool in zoo medicine, it is no longer the only option to provide veterinary care for these animals.

Protected contact positive reinforcement training now plays a vital role in providing veterinary care both globally and at the North Carolina Zoo. Through medical behavior training, animals willingly participate in their own healthcare. This training philosophy emphasizes choice and control while providing a safe working environment for both the animal and trainer. With patience, trust, and positive reinforcement, a pregnant chimpanzee may allow an ultrasound of her abdomen, an elephant might present an ear vein for blood collection, a bear could present its shoulder for a vaccine injection, and a giraffe might step onto a protected plate for foot radiographs.

There is enormous potential for what can be accomplished with behavioral training, but it is not without challenges. Animals, like people, have unique personalities and can experience different moods or fears. Sometimes, simply finding a reward that an animal is willing to work for can be its own challenge. Precise timing is essential to avoid inadvertently reinforcing unwanted behaviors. Body language and tone of voice can also play a large part in the progress

of training a new behavior. Something as subtle as wearing a differently colored shirt or a new perfume can regress a behavior.

When established, these behaviors might seem effortless, but they are a testament to the dedication and skill of the Animal Care Team and their bond with each animal. The relationship they build with the animals is grounded in trust and requires considerable time and patience. While a behavior that facilitates blood collection does not eliminate the sharp poke of the needle, it reflects the trust between the animal and the care team to allow them to collect that sample. Through collaboration between the Veterinary and Animal Care Teams we achieve a higher level of animal welfare while providing necessary healthcare to the animals at the North Carolina Zoo.

– Kelly Tardif, MS, RVT

“Protected contact positive reinforcement training now plays a vital role in providing veterinary care both globally and at the North Carolina Zoo.”



OUTREACH



The Animal Health Team at the North Carolina Zoo plays a crucial role in wildlife conservation and research, serving as both caretakers and scientists. Our involvement extends far beyond the immediate health and welfare of animals in managed care, encompassing a broad range of activities aimed at preserving biodiversity and advancing the understanding of animal health and behavior. Our team members are often at the forefront of developing and implementing conservation strategies that address the complex needs of human-managed and wild populations.

In addition to clinical animal care, we are actively involved in conservation efforts. Our team members have conducted health surveys and assessments on endangered species to establish baseline parameters and track health trends over time. We are also highly involved in wildlife rescue, rehabilitation, and release programs for native North Carolina wildlife. Notably, the Zoo's longest-running field conservation program was established by the Zoo's Animal Health Section to address human-elephant conflict in northern Cameroon, Africa. By bringing our skills and knowledge to the field, the Animal Health Team helps bridge the gap between ex-situ and in-situ conservation efforts, ensuring a more comprehensive approach to wildlife conservation.

In our research efforts, we offer valuable insights through our expertise in comparative physiology and anatomy, disease transmission and prevention, health assessment, public health, and transdisciplinary teams. We conduct studies on a wide array of species, many of which are endangered or poorly understood. This research is crucial for improving animal care and management practices in zoos and informing conservation efforts in natural habitats.

Educational outreach is another critical aspect of the Animal Health Team's role in conservation. We raise public awareness about conservation issues, emphasizing the importance of protecting endangered species and their habitats. Through lectures, workshops, and media engagement, we aim to inspire the public to support conservation initiatives. We are training the next generation of conservationists and veterinarians!

Our comprehensive understanding of animal health and welfare, combined with our commitment to preserving biodiversity, makes us key players in the global effort to protect and sustain wildlife populations for future generations.

CONSERVATION MEDICINE



ELEPHANTS IN CÔTE D'IVOIRE

Jb Minter

In 1998, the North Carolina Zoo launched a major conservation initiative to study the movement and habitat needs of forest elephants in Northern Cameroon, Africa. Over the next two decades, Dr. Mike Loomis, the Zoo's Chief Veterinarian emeritus, collaborated with the World Wildlife Fund (WWF) and local agencies to use GPS satellite tracking to address elephant conservation issues in Central and West Africa, including Cameroon and Nigeria. By 2018, Dr. Loomis and I expanded these efforts by partnering with the Ministry of Waters and Forests and the Ivorian Office of Parks and Reserves in Côte d'Ivoire.

Historically, Côte d'Ivoire had one of the largest elephant populations in West Africa, and its colonial name, Ivory Coast, reflected the region's significant elephant presence. Unfortunately, human activities such as poaching and habitat destruction for agriculture and development have severely impacted these populations. Forest elephants are particularly affected as their habitat is lost to expanding human settlements, which leads to increased human-elephant conflict (HEC) as elephants migrate longer distances or invade agricultural areas in search of food.

Compared to African savanna elephants, the biology and behavior of forest elephants are still poorly understood. Given the intense poaching pressure, gathering information on habitat use, seasonal and annual land-use patterns, and ecology is critical for maximizing the effectiveness of conservation efforts. By using GPS satellite tracking technology, we have been able to monitor elephant movement patterns in

“This technology has helped us anticipate where elephants may encounter poachers.”

real-time and identify several key migration routes. This technology has helped us anticipate where elephants may encounter poachers and alert rangers when herds are heading toward human settlements, thereby reducing the risk of human-elephant conflict.



LAVA GULLS IN THE GALAPAGOS ISLANDS

Megan Cabot

Thanks to the support of the North Carolina Zoo and North Carolina State University, I was able to travel with my very good friend and veterinary colleague to the Galapagos Islands, where we performed health assessments on the world's rarest gull, the lava gull. These dusky grey birds have black beaks and feet and white eyeliner. They roost in pairs in the crevices of the black lava rocks and scavenge the beaches for food, calling to each other with the classic gull laugh.

Accompanied by a conservation researcher, we journeyed across the islands of San Cristobal, Santa Cruz, and Isabela. We boated to remote beaches, climbed along cliffsides, and frequented fish markets to track down these elusive birds. As we found them, we took morphometric measurements, measured vital signs, collected samples, and banded each bird with individual numbers so that the research team could monitor the health of the birds now and into the future. With the bands, the team can also determine where the birds live, their family dynamics, and how far they travel.

Contributing to conservation research in such an iconically wild and natural place was a lifelong dream come true. The memories made there continue to inspire my work at the Zoo, caring for all of the animals that inhabit this earth and supporting the conservation of the ecosystems that they call home.

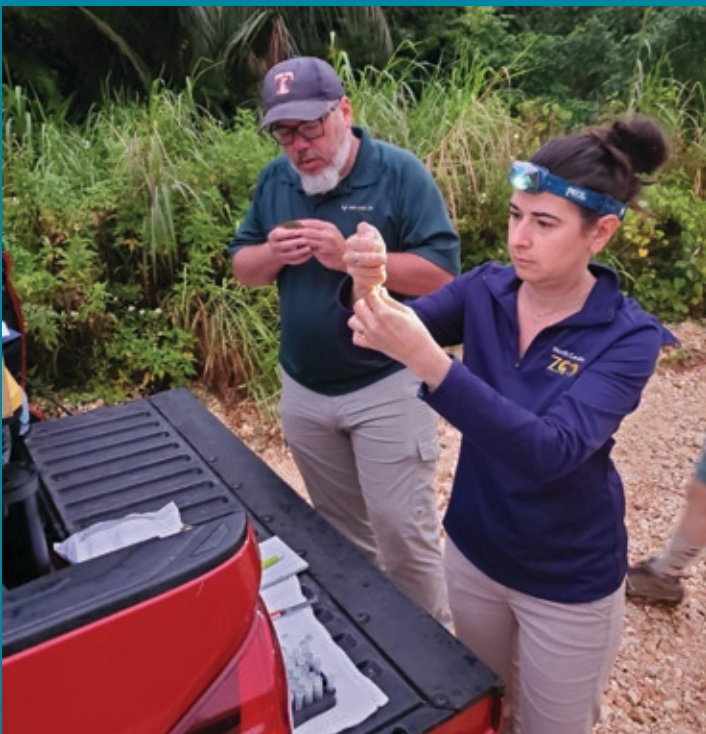


AVIFAUNA IN THE MARIANA ISLANDS

Heather Scott

The Mariana Islands in the western Pacific consist of Guam, a U.S. territory, and the 14 Northern Mariana Islands, a U.S. commonwealth. In the 1940s, the brown tree snake was accidentally introduced to Guam, which led to the extinction of numerous native bird species by the 1980s. The Mariana Avifauna Conservation (MAC) Program was established to prevent a similar fate for birds on the Northern Mariana Islands, and the Zoo has been supporting MAC for over a decade. I have had the opportunity to travel to the Mariana Islands to assist the MAC program in capturing and caring for birds that need to be relocated to snake-free islands. Moving these sensitive species to uninhabited islands creates assurance populations that are less at risk from brown tree snakes.

As the veterinary hospital manager and a registered veterinary technician with a specialty in zoo medicine, I have provided on-site veterinary care to these birds since 2018. Recently, I was involved in efforts to move 100 rufous fantails and 93 golden white-eyes from Saipan to Alamagan. The captured birds received health exams, were banded for future monitoring, and released with ongoing oversight by local biologists. It has been incredibly rewarding to play a role in preserving these unique species and helping ensure their future on the islands.





CLINICAL RESEARCH



CHIMPANZEE COAGULATION PROFILES

Lauren Mumm

Heart disease and cancer are common causes of illness in great apes in managed care. These afflictions are known to affect blood clotting pathways in many species, including humans. Through this project, we explored the efficacy of a novel diagnostic tool, the Viscoelastic Coagulation Monitor (VCM Vet™), in chimpanzees. This device evaluates the kinetics of blood clotting and has recently become popular in veterinary medicine. It is portable, requires only a small amount of blood to run a test, and produces results in one hour. We have collaborated with seven other institutions and collected data from over twenty chimpanzees in the last year to include in this study. Validating this tool has the potential to provide information for faster medical interventions, reduce morbidity and mortality, and contribute to successful efforts to sustain this critically endangered species for the future.



VISIBLE IMPLANT ELASTOMER IN TOADS

Megan Cabot

Telling toads apart can be tough, so researchers developed a liquid plastic marker that can be inserted under the skin of toads to individually identify them. The product is available in various colors including some that fluoresce under a black light. It is injected as a liquid but solidifies into a permanent identification tag under the toad's skin. Many studies have shown that the tags are harmless in the skin, but they can break apart over time and even disappear. Our team evaluated a large number of toads with these tags placed in their back leg to determine where the material goes when it disappears. We discovered that the toads absorb the plastic into their bloodstream, where it circulates throughout the body before accumulating in the kidneys, lighting up beautifully under a black light on a microscope slide. Understanding this process is crucial as it can cause kidney inflammation and impact research results in toads identified with this type of tag.



GI MICROFLORA OF RHINOS

Christina Burnham

The gut microbiome plays a vital role in digestion, immunity, and the overall well-being of its animal host. In order to investigate the gut microbiome of female southern white rhinoceros, as a graduate student working with the Animal Health Team, I extracted and sequenced microbial DNA from fecal samples of all 8 rhinos at the North Carolina Zoo. We discovered the composition of the rhinos' gut microbiomes varied depending on their life stage, likely reflecting changes in diet and behavior over time.

Additionally, seasonal changes and reproductive status also influenced the gut microbiome. Remarkably, nonreproductive female rhinos harbored specific bacteria previously linked to poor reproductive outcomes in livestock, though further research is necessary to confirm similar interactions in rhinos. This research provides valuable insights that could improve management of rhinoceros populations, potentially enhancing their reproductive success and supporting the species' long-term survival amid ongoing threats such as poaching and habitat loss in the wild.



RED WOLF GENETICS

Megan Cabot

The North Carolina Zoo is home to a breeding population of the critically endangered American red wolf. Although this species once went extinct in the wild, dedicated efforts by zoos and conservation centers have successfully reintroduced them to a protected natural area in North Carolina. The wolves at the Zoo are housed out of the public eye to keep them wild and allow natural breeding and even potential release.

Recently, the Zoo's Animal Health Team identified a syndrome in the Zoo's red wolf pack characterized by extreme heat sensitivity, which could impact their chances of being released back into the wild. To address this, we initiated a multi-year genetics study with support from the Red Wolf SAFE® Program and the Wild Animal Health Fund, and in collaboration with the Canine Genetics Lab at the University of Minnesota and the Point Defiance Zoo and Aquarium. The goal of this study was to explore the red wolf genome for the underlying cause of this condition. The results from this study can be used to help strengthen the species' genetics and support the ongoing efforts to conserve the American red wolf.



PUBLICATIONS

2022–2023

As part of the Zoo's commitment to advancing zoological veterinary medicine, the Animal Health Team publishes the valuable information garnered through our research and projects. These peer-reviewed publications in scientific and veterinary journals enable us to share the knowledge that shapes the expert animal care at the North Carolina Zoo with colleagues and stakeholders around the world.

Burnham, C. M., McKenney, E. A., Ange-van Heugten, K. A., **Minter, L. J.**, & Trivedi, S. (2023). Effects of age, seasonality, and reproductive status on the gut microbiome of southern white rhinoceros (*Ceratotherium simum simum*) at the North Carolina Zoo. *Animal Microbiome*, 5(1), 27.

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Cassady, K. R., **Minter, L. J.**, & Gruber, E. J. (2023). Performance of a manually operated salad spinner centrifuge for serum separation in the healthy domestic horse (*Equus caballus*) and southern white rhinoceros (*Ceratotherium simum*) (Vol. 52, No. 4, pp. 628–637).

Cassady, K. R., Balko, J. A., Bailey, K. M., Posner, L. P., Robertson, J. B., & **Minter, L. J.** (2023). Evaluation of Oscillometric Blood Pressure Measurement Using A Finger Cuff in Anesthetized Chimpanzees (*Pan troglodytes*). *Journal of Zoo and Wildlife Medicine*, 54(1), 16–22.

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**TRAINING THE
NEXT GENERATION**

THE ZOOLOGICAL MEDICINE RESIDENCY

HISTORY OF THE RESIDENCY

In the summer of 1989, two veterinarians in the nascent specialty of zoological medicine arrived at the College of Veterinary Medicine (CVM) at North Carolina State University (NC State). Michael Stoskopf and Suzanne Kennedy-Stoskopf were previously faculty at Johns Hopkins University and were among the first veterinarians to take the examination to become board certified in the newly formed American College of Zoological Medicine (ACZM). In their new roles at the CVM, they set out to establish an exemplary training program for zoological health specialists. Their first point of action was to arrange a meeting with Bob Frey, the charismatic Director of the North Carolina Zoo (Zoo). They were pleased to discover that Director Frey recognized the value of, and encouraged, a collaboration between the new major assets of the state, the CVM and the Zoo.

To launch this collaborative training program, it was apparent that a strong partner at the Zoo would be critical. Mike Loomis was an early veterinarian for the Zoo who had developed the Zoo's veterinary program, established early relationships with the CVM, and supervised the construction of the Hanes Veterinary Medical Center before being lured back to his home state of California for a position at the famed San Diego Zoo. Drs. Stoskopf and Kennedy-Stoskopf were well acquainted with Dr. Loomis, as they had worked together in the challenging first years of the ACZM board, helping it survive to become an important catalyst for the discipline. Dr. Loomis' return to the Zoo created the critical mass needed for the foundation of the NC State Zoological Medicine Residency.



The concept of the residency was based on a three-legged stool of excellence in clinical acumen, clinical research to advance the field, and, equally important, willingness and ability to provide leadership within the discipline. By the summer of 1991, the first resident in the new three-year training program was beginning an adventure in education unique to the field. The first residents were outnumbered by faculty and experienced extensive, if not exasperating, mentoring. These veterinarians were constantly challenged to develop skills relevant to each leg of the proverbial stool as they participated in the most demanding training program in zoological medicine. Each of these veterinarians has gone on to make their mark in the field as exemplary clinicians, researchers, and, above all, leaders.

The very first resident in our program is an excellent example of someone who has made major contributions to the discipline. Since her inaugural residency, Lucy Spelman has worked as a clinical veterinarian, educator, media consultant, writer, and director of a major zoo. She is currently a senior lecturer of History, Philosophy, and Social Sciences at



the Rhode Island School of Design, and is a founder and Executive Director of Creature Conserve, a nonprofit organization dedicated to combining art with science to cultivate new pathways for wildlife conservation.

The second resident, Craig Harms, was a Harvard graduate and the first aquatics-focused resident in the program. He went on to complete a PhD in immunology under Dr. Kennedy-Stoskopf, studying the immune system of fishes, and stayed at NC State to become the Director of Marine Health at the University's Center for Marine Science and Technology. He currently leads the residency program, teaches veterinary students and undergraduates, conducts important research on a wide range of aquatic species, and serves on several key boards, including a leadership role in the examination of marine mammal mortality events in U.S. waters.

Ted Mashima, the third resident and first wildlife-focused resident, has become an extremely well-respected leader in veterinary medicine. He is an entrepreneur who led several nonprofit organizations and foundations after teaching and mentoring in his role as Associate Director for the Center for Public and Corporate Veterinary Medicine at the Virginia-Maryland College of Veterinary Medicine. He served as president and Executive Director of the Asian & Pacific Islander American Scholarship Fund, and Projects Director for the National Association of Physicians for the Environment. He is a Fellow of the National Academies of Practice and is currently Senior Director for the Academic and Research Affairs for the American Association of Veterinary Medical Colleges.

We are proud to say that our residents often have global impacts. Felicia Nutter joined our program and completed a PhD working with Dr. Stoskopf at NC State. She has since gained extensive field experience around the world serving as a faculty member in the Department of Infectious Disease and Global Health at Tufts College of Veterinary Medicine. Gladys Kalema was recruited by Dr. Loomis and joined our program from Uganda. Her strengths led her to spend the end of her residency participating in a Duke University program through which she taught non-governmental organization (NGO) foundation and operation. There, she formed Conservation Through Public Health, a Uganda-based nonprofit organization dedicated to the coexistence of endangered mountain gorillas, other wildlife, humans, and livestock. Tres Clark, always willing to give new experiences a try, actually had the role of the veterinarian in the movie *Jurassic World*, filmed in New Orleans while he was practicing at Audubon Nature Institute following his residency. He later became a clinical veterinarian at SeaWorld San Diego before taking on his latest challenge as Director of Animal Health and Welfare at SeaWorld Yas Island, Abu Dhabi, the largest aquarium facility in the world.

Other former residents have made their mark right here in North Carolina, becoming valuable members of the residency. Ryan DeVoe joined the staff at the Zoo after his residency and filled the role of Senior Veterinarian under Dr. Loomis for many years before joining the burgeoning concentration of our former residents at Walt Disney World's Animal Kingdom. Dr. DeVoe trained Jb Minter, an outstanding resident who had a strong understanding of the complexities of zoo administration and an interest in leading and

developing the Zoo's Animal Health program. Dr. Minter, of course, went on to become the Director of Animal Health at the Zoo. Dr. Minter trained Megan Cabot, our recent resident, who has now passed boards and joined the ranks as Associate Veterinarian of the Zoo. Now residency mentors themselves, Dr. Minter and Dr. Cabot also work with former residents Lori Westmoreland, veterinarian, and Emily Christiansen, head veterinarian, who train the current residents in aquatic animal medicine at the North Carolina Aquariums.

Furthermore, the residents and faculty in the program have taught and mentored innumerable veterinary students over the past three decades, many of whom have taken their own paths to become successful zoo veterinarians in our field. This is probably also a good time to mention the many veterinarians who have pursued master's and PhD credentials relevant to zoological medicine, benefiting from important time spent at the Zoo learning from and collaborating with our residents, mentors, and Zoo staff.

Since 1991, over 40 amazing veterinarians have trained in what became, arguably, the most successful program of its kind. Unfortunately, there is not enough room in this article to wax eloquent about them all. However, they have all made their mark while in the residency and beyond. They have each contributed to the growth of the broad and demanding discipline of zoological medicine and continue to accomplish great things in their careers. Through the contribution of countless faculty, adjunct faculty, and Zoo staff, the collaboration between the Zoo and NC State CVM has become a model for teaching programs around the country and in Canada. The NC State Zoological Medicine Residency continues its legacy today, training the next generation of unique and excellent zoo veterinarians at the North Carolina Zoo.



– Michael Stoskopf, DVM, PhD, DACZM
Professor Emeritus
Wildlife and Aquatic Health
North Carolina State University

MEET THE RESIDENTS



LAUREN MUMM

Lauren is originally from Rogers, Minnesota, and completed her veterinary degree at the University of Illinois. Her favorite part of being a zoo veterinarian is anesthetizing dangerous animals to provide the care they need. Her favorite animal at the Zoo is the Komodo dragon, Pandai.



LAURA MARTINELLI

Laura Martinelli is from Wisconsin and attended veterinary school at the University of Wisconsin-Madison. As a zoo vet, Laura's favorite cases include an emergency C-section on a lion, cystotomy on a black bear cub, and cataract surgery on a sea lion.



ASHLEY SOUZA

Ashley was born in Raleigh, North Carolina, and went to NC State for vet school. Her favorite zoo animal is the snow leopard. When not studying for the board exam, she loves white-water rafting and having a book in her hand.



HAYLEY STRATTON

Hayley Stratton is from North Carolina and attended veterinary school at NC State. Outside of work, she enjoys hiking, reading, and spending time with her tripod cat.



OUTGOING: NICK DANNEMILLER

Originally from Portland, Oregon, Nick Dannemiller received his undergraduate degree in Fish, Wildlife, and Conservation Biology as well as a Doctorate of Veterinary Medicine from Colorado State University. Following veterinary school, Nick survived a small animal rotating internship at Angell Animal Medical Center in Boston before starting the Zoological Medicine Residency at NC State University, the North Carolina Aquariums, and the North Carolina Zoo. His favorite aspects of being a part of the Zoo's Animal Health Team are helping teach visiting students and identifying new diagnostics or treatments to improve patient care, regardless of size or species. After finishing his final year of the residency, Nick successfully passed the board exam to become a Diplomate of the American College of Zoological Medicine and headed back home to the West Coast to become an associate veterinarian at the San Francisco Zoo.



INCOMING: MEGAN ROEDER

Megan Roeder is the incoming first year Zoo Medicine-focused resident. She attended veterinary school in her home state of Colorado. After graduation, Megan traveled all over the U.S. for training positions. She completed a zoo and small animal internship at Louisiana State University, practiced emergency medicine at the University of Tennessee, and undertook a zoological medicine fellowship at Binder Park Zoo in Michigan before joining our residency program. She chose this residency as an opportunity to be well-rounded as a clinical practitioner, teacher, and researcher. While zoo medicine is her passion, she is excited to incorporate wildlife rehabilitation into her training and gain confidence in aquatic animal medicine. Outside of work, you might find Megan hiking with her dog "Yeti", doing yoga, or buying more house plants. In the long list of her favorite animals, she has a special affinity for red pandas, snow leopards, and giraffes.



WHERE ARE THEY NOW?

Lucy Spelman, DVM, DACZM

Ocean State Veterinary Specialists, East Greenwich, Rhode Island

Craig Harms, DVM, PhD, DACZM, DECZM (ZHM)

North Carolina State University, Raleigh, North Carolina

Ted Mashima, DVM, DACZM, DACVPM

Assoc. of American Veterinary Medical Colleges, Washington DC

Maryanne Toci dlowski, DVM, DACZM

Houston Zoo, Houston, Texas

Andrew Stamper, DVM, DACZM

Walt Disney Company, Bay Lake, Florida

Felicia Nutter, DVM, PhD, DACZM

Tufts, North Grafton, Massachusetts

Kurt Sladky, MS, DVM, DACZM, DECZM (ZHM)

University of Wisconsin, Madison, Wisconsin

Elizabeth Chittick Nolan, DVM, MS, DACZM

Walt Disney Company, Bay Lake, Florida

R Scott Larsen, DVM, MS, DACZM

PennVet Wildlife Futures Program, Philadelphia, Pennsylvania

Gladys Kalema-Zikusoka, BVetMed, MSpVM, MBA

Conservation Through Public Health, Uringi Crescent, Entebbe

Pamela Govett, DVM, DACZM

Govett Consulting, Miami, Florida

Ryan Devoe, DVM, MSpVM, DACZM, DABVP

Walt Disney Company, Bay Lake, Florida

Terra Kelly, DVM, PhD, DACZM

EcoVet Global, Berkeley, California

Robert MacLean, DVM

Audubon Nature Institute, New Orleans, Louisiana

Allison Tuttle, DVM, DACZM

Mystic Aquarium, Mystic, Connecticut

Karen Wolf, MS, DVM, DACZM

Point Defiance Zoo & Aquarium, Tacoma, Washington



Sathya Chinnadurai, DVM, MS, DACZM, DACVAA, DACAW | Chicago Zoological Society, Brookfield, Illinois

Betsy Stringer, DVM, DACZM
Walt Disney Company, Bay Lake, Florida

Eric Anderson, DVM, DACZM
Mystic Aquarium, Mystic, Connecticut

Elsburgh "Tres" Clarke, DVM, DACZM
SeaWorld Abu Dhabi, Abu Dhabi, United Arab Emirates

Larry "Jb" Minter, MS, DVM, DACZM
North Carolina Zoo, Asheboro, North Carolina

Emily Christiansen, DVM, MPH, DACZM
North Carolina Aquariums, Morehead City, North Carolina

Jenessa Gjeltrema, DVM, DACZM
University of California Davis, Davis, California

Brianne Phillips, DVM, DACZM
Zoo New England, Stoneham, Massachusetts

Sarah Cannizzo, MA, VMD, DACZM
Fort Worth Zoo, Fort Worth, Texas

Lori Westmoreland, DVM, DACZM
North Carolina Aquariums, Morehead City, North Carolina

Michelle Whitehead, DVM, DACZM
University of Illinois, Urbana, Illinois

Kate Archibald, DVM, DACZM
Omaha's Henry Doorly Zoo and Aquarium, Omaha, Nebraska

Greg Scott, MA, DVM, DACZM
Georgia Aquarium, Atlanta, Georgia

Meghan Louis, DVM, DACVPM, DACZM
United States Army, Hawaii

Emma Houck, DVM, DACZM
Oregon Zoo Portland, Oregon

Alissa Mones, DVM, DACZM
Virginia Aquarium & Marine Science Center, Virginia Beach, VA

Kyra Knutson, DVM, DACZM
Oradell Animal Hospital Paramus, New Jersey

Megan Cabot, DVM, DACZM
North Carolina Zoo, Asheboro, North Carolina

Caitlin Hepps Keeney, DVM, DACZM
Columbus Zoo and Aquarium, Powell, Ohio

**40 RESIDENTS
TRAINED**

STUDENT TEACHING



CLINICAL YEAR VETERINARY STUDENTS

Each year, clinical veterinary students travel from various veterinary schools across the country to spend a month or more learning from the Animal Health Team at the North Carolina Zoo. These students, who are in the final year of a four-year doctoral program to become veterinarians, have the opportunity to learn about the medical care of the wide array of species under the Zoo's care. Students participate in our daily activities, such as administering anesthesia, conducting physical exams, and performing surgeries. They learn how to interpret blood work and radiographs and gain a realistic understanding of what it is like to be a veterinarian at a zoo. We provide guidance on the additional training required to be a zoo veterinarian after veterinary school and continue to mentor those who choose to take on that post-doctoral training and studying to one day become zoo veterinarians.



WILDLIFE REHABILITATION CENTER INTERNS

The Wildlife Rehabilitation Center (WRC) at the North Carolina Zoo is dedicated not only to providing veterinary and rehabilitative care to native wildlife but also to educating future animal caretakers, veterinarians, and researchers in responsible and respectful wildlife care. At the WRC, we have a well-established internship program that attracts undergraduates from all over the United States and collaborates with various education programs.

Interns gain comprehensive experience through hands-on training and structured educational content. They learn about all facets of wildlife rehabilitation, including interacting with the public, admitting and triaging patients, preparing diets, performing daily care for orphaned and injured animals, and assisting with veterinary treatments and procedures. The internship is accredited by the International Wildlife Rehabilitation Council and was listed in the top 15 programs by Animal Career Experts in 2018. More information about this unique internship opportunity can be found at www.nczoo.org/interns.



LEARN
MORE



THE NEXT GENERATION

Since its inception in 2009, the North Carolina Zoo's Veterinary Camps have offered children a unique opportunity to dive into the world of veterinary medicine through immersive, hands-on learning experiences. This program was designed to foster and nurture a passion for animals and science among young participants, allowing them to explore various facets of veterinary care in a vibrant and creative environment.

Over the years, the program has evolved to enhance its educational offerings yet remains dedicated to engaging campers with the core principles of veterinary medicine. The Zoo's Animal Health Team plays an integral role in guiding the campers through the behaviors of different species, demonstrating diverse diagnostic techniques, and explaining how we maintain the health and well-being of the Zoo's animal residents.

Campers benefit from direct interactions with live animals, educational models, and practical

demonstrations, which help them apply their newly acquired knowledge. The curriculum covers essential skills such as physical exams, animal handling, bandaging, radiology, pet CPR, anesthesia monitoring, surgery, and darting. Beyond these technical skills, the program emphasizes vital attributes for effective veterinary practice, including compassion, empathy, problem-solving, communication, teamwork, and adaptability.

The Zoo's Animal Health Team is consistently invigorated by the enthusiasm of the campers, whose eagerness to learn about veterinary medicine brings a dynamic energy to the program. This excitement not only enhances the educational experience for the campers but also reinforces our commitment to sharing our expertise and passion for animal care. Overall, the Veterinary Camps continue to inspire and educate the next generation of animal care professionals, making a lasting impact on both the participants and the Zoo's Animal Health Team.



HELLO FROM THE HOSPITAL

As we wrap up another exceptional year at the North Carolina Zoo, I am incredibly proud of the progress the Zoo has made in veterinary care and animal welfare. Our dedicated Animal Health Team has worked diligently to provide top-notch medical attention, performing countless routine exams, surgeries, and emergency interventions. These efforts underscore our commitment to the health of the Zoo's diverse animal residents and local wildlife.

We have successfully implemented new health monitoring protocols and preventative care measures, leading to better overall health outcomes for our animals. Additionally, our ongoing research collaborations have enabled us to contribute valuable insights into wildlife health, furthering conservation efforts both locally and globally.

I am deeply grateful for our remarkable team, whose passion and expertise help drive our success, and to our community of supporters whose contributions aid our mission. Beyond the role of healers, the Veterinary and Wildlife Rehabilitation Center Teams are also educators and innovators. Together, we continue to create a safe and nurturing environment for the Zoo's animals, while advancing the field of veterinary medicine. Here's to another year of growth, innovation, and unwavering dedication to the animals we cherish.

Sincerely,
Jb Minter, MS, DVM, Dipl ACZM
Director of Animal Health



@dr.jbminterdvm

GET INVOLVED

The North Carolina Zoo Society, the private 501(c)3 established for the sole purpose of supporting the North Carolina Zoo, offers unique opportunities for donors to support the Zoo's animal health initiatives. Friends of the Zoo can donate directly to specific needs requested by the veterinary staff or participate in fund-raising experiences that support the general needs of the Zoo's Conservation Medicine or Staff Development programs.

VET CAMP

Donors with children or grandchildren who dream of becoming a zoo veterinarian can enroll them in one of the Zoo Veterinary Camps sponsored by the Zoo Society. These camps are suitable for rising 7th through 12th graders. The Zoo's veterinary staff teaches the camp sessions inside the Zoo's veterinary hospital, and camp counselors are all attending veterinary school. Learn more by choosing the "Extraordinary Experience" option at nczoo.com or scanning the QR code.



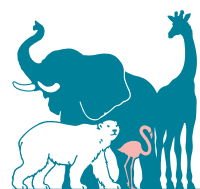
SHADOW A VET

Donors interested in the Zoo's veterinary operations may sign up for one of the Animal Health Section's "Shadow a Veterinarian" experiences. Shadowers join one of the Zoo's veterinarians for either a half or a full workday to see, up close and in person, some of the ways that zoo veterinarians care for wild animals. These programs are explained in detail under the "Extraordinary Experiences" menu option at nczoo.com and can be accessed by scanning the QR code.



DONATE DIRECTLY TO THE VETERINARY HOSPITAL

Donors may give directly to support veterinary needs by visiting nczoo.com and choosing the "Caring for Animals" option under the "Give to the Zoo" menu option. Scan the QR code using a smartphone camera to directly access the "Caring for Animals" donation page.



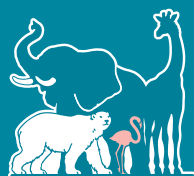
Saving a Piece of
the World for its Wildlife

NC Zoo Society





North
Carolina **ZOO**
AND BOTANICAL GARDENS



Saving a Piece of
the World for its Wildlife

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NC DEPARTMENT OF
NATURAL AND CULTURAL RESOURCES