

Innovative approach forges rhino footwear :

Tye Chandler, Marketing Associate : Fossil Rim Wildlife Center

An angel gets its wings, and at Fossil Rim Wildlife Center, a rhino gets her boots.

Coco, a 25-year-old southern black rhino, has lived at Fossil Rim since 1995. At age six, she began to have issues with her right front foot.

"We've treated it a number of different ways," said veterinarian Dr. Holly Haefele, director of animal health. "In 2009, we put a boot on for about a month and got good resolution to the problem for about five years. In August 2014, she started having trouble with the right front again. We think there potentially used to be (a foreign object) in there that flared up in the foot pad and opened up a hole. "Even if nothing is in there any longer, maybe now it's hard for normal tissue to grow back. We tried to address it again last spring, but we've had trouble keeping boots on her and didn't have any of the success we had with the boot in 2009."

Adam Eyres, hoof stock curator, estimates that 20-plus boots constructed of various materials have been made for Coco over the years, but none proved to be a permanent solution. In fact, Coco recently developed problems with her left foot as well. "Now, Coco has a lesion on her left front foot, too, from bearing weight on it because she favors her front right," Haefele said. "We noticed it (last April)."

Enter Christine Bobko, president of Diceros Boots LLC and rhino keeper at the Denver Zoo. She has brought cutting-edge technology to the rhino boot market. The black rhino is her specialty. "I developed this boot in conjunction with a medical case for one of our black rhinos," Bobko said. "I was trying to do the same thing you all are trying to do here – keep the foot clean and dry. In conjunction with an artist, Landen Meier of Hyperflesh, we came up with a way to cast very quickly to make custom-formed elastomer boots.



Minutes after receiving her Diceros Boots, Coco takes them for a spin with a trot in her pen.

"They are super soft. For a rhino, it's like having their own Dr. Scholl's insole. We have a patent filed and are expanding to the canine and equine industry."

Having worked with rhinos for 27 years, Bobko has known Eyres for about 25 years.

"I presented a paper at the (International Rhino Keeper Association) workshop in Chester (England) this past June on our whole process and the treatment case of our rhino," she said. "Justin (Smith, Fossil Rim senior animal care specialist – hoof stock) was there, and he told me afterwards that he had the same rhino case at Fossil Rim. From there, I talked to Adam and sent photos of what we were doing."

"I feel like we produce a good product, and the problem (at Fossil Rim) has been trying to keep anything on the feet of this rhino. Our product is so custom-formed that there is a high likelihood we'll be able to keep this boot on (Coco) for at least two weeks."

Before Bobko made the trip to Fossil Rim Oct. 16, Coco's last immobilization was June 15. "We cleaned her feet at that point," Eyres said. "When we have the boots (from Christine), we'll clean her feet again and allow the wounds to heal. The critical thing is to protect the holes in her feet from further infection. That's what the boots will do."



During Christine Bobko's initial visit in October, it was all hands on deck with 22 people from Fossil Rim and other institutions working and/or observing



Making the mold

When Bobko initially arrived at Fossil Rim, the plan was to figure out what size Coco's boots needed to be while also performing various health assessments and keeping her safe. "Compared to sedating one of our other animals, rhinos and giraffes are different because of how much they weigh and the pressure that puts on their organs," Eyres said. "You worry about how long they are down."

"To keep medication on the wound and keep it clean – that's why we want to have a good boot," Haefele added. "We had to get Christine the info she needed so we can try the new technology of her boots."

The key for Bobko was to come away with a silicone mold of each front foot. "We had to make molds of both front feet, because you can't assume they're exactly the same and every boot is custom-made," she said. Weighing just over four pounds each upon completion, the new boots' soles are urethane, the orange portion of the upper is silicone and the black portion is Gore-Tex. "These are orange because that type of silicone provides better flexibility and strength than the purple version I brought initially as an example," she said during her return to Fossil Rim. "If needed, we could customize the color."

While Bobko and her husband Brian Teasdale, boot engineer, were getting the measurements they needed during the October sedation, Haefele and others on the scene had plenty to keep them occupied. "We had to monitor her anesthesia level and how she was doing physiologically," Haefele said. "Such a big animal can end up in trouble while immobilized with issues like muscle trauma while laying on one side, not breathing well on opioids or any number of things. Dr. Nancy Lung, the head vet at the Fort Worth Zoo, was in charge of monitoring the blood gases. Coco actually did really well and is a good anesthetic patient."

As Coco's feet were being cleaned and having the silicone applied, Haefele took measures to treat and protect her. "We put tourniquets on her (front) limbs to concentrate antibiotics in those areas for about 25 minutes during the immobilization," she said.



Brian Teasdale, Diceros Boots engineer, preps to make molds for each of Coco's front feet. After mixing, Teasdale had a short window of time to apply the silicone and molding strips to the rhino's feet before the solution solidified.



Brian Teasdale applies silicone to molding strips that were wrapped around each of Coco's front feet in order to form molds leading to the creation of her boots.

Haefele also radiographed the rhino's feet to make sure the bones in her toes weren't changing due to infection. "We also gave her IV fluids and drew blood," she said. "She is our only rhino that won't stand, unsedated, to have her blood drawn." On that note, Coco is the lone rhino that won't allow herself to be hand injected for sedation, so she had to be darted as the staff might do for an animal like a zebra.

Even with Bobko in town, Haefele and Eyres were still driven to discover a successful boot option of their own. "We've been talking about trying to get someone to build her a leather boot, which would hopefully stay on and be lightweight," Haefele said. "We did a cast of her foot to give a bootmaker her dimensions. I hope Christine's boots work, but there is no problem with having multiple options."

Team effort

There were 22 people on the scene during Coco's October immobilization, which lasted roughly 90 minutes, including Fossil Rim staff, Bobko and her husband, Fort Worth Zoo staff, Abilene Zoo staff and Dr. Lisa Stephens, an equine vet from Weatherford. Although several people were specifically requested to be there, Eyres said many were present because Fossil Rim is "a teaching facility."

"With a rhino immobilization, you need a certain number of people there in case you need to move it," Haefele said. "I love having Dr. Stephens there, and she enjoys helping us out often. Dr. Lung has done a lot of rhino immobilizations, so she brings great experience. I can't concentrate on the feet and monitor Coco's anesthesia, so we parse those things out."



Brian Teasdale paints silicone onto the molding strips wrapped around Coco's foot during the process of creating a mold for each of her front feet.



Brian Teasdale removes the silicone mold from Coco's foot. The zipper for the actual boot was applied where he made the split in the mold.



Christine Bobko and Coco's mold

"Plus, when you have a black rhino immobilization, we try to offer that opportunity to people from other institutions. A lot of zoos don't do them often, and the doctor from the Abilene Zoo had only participated in Indian rhino immobilizations before. You can never see enough of these, because every time you do, they're different."

Bobko estimated it could take up to three weeks to get Coco's boots ready, after which point she planned to return from Denver.

"This product concept was developed for the love of a very special rhino named Mshindi that I worked with for 21 years and created 29 variations of boots for," she said. "Now, his spirit drives everything we're doing, and that's what is at the core of Diceros Boots. Our mission is "saving species one step at a time". The people at Fossil Rim have been amazing to work with, and I can't express my gratitude in being given the opportunity to possibly help Coco."

Eyres remained hopeful that if the boot fits, Coco will wear it.

"Christine is starting up her company, and this could be a win-win," he said. "If we get a good product, she gets good press out of it and then more customers."

Time to build



Michael Birt, animal care specialist – hoof stock, holds up one of Coco's back legs to keep her blood circulating during an immobilization.

When Bobko returned to Colorado, there was plenty to be done.

"From the silicone mold we got during our first trip to Fossil Rim, we had to make a female plaster mold," she said. "There were certain modifications that had to be made to it. We put a smoothing compound over the entire silicone mold, and then I hand-sanded all the irregularities out of the plaster mold to prevent rubbing inside of the boot. After the boot is formed, the next step is internal sewing. "Brian uses two industrial sewing machines for that. The final step is sewing the bottom piece onto the boot (upper). All in all, it's a four-step process with about 40 hours of work on each boot."

With the process for these Diceros Boots still in its infancy, Bobko is looking to upgrade the process. "We now have a 3D imager and a 3D printer, so we're trying to make our process more high-tech," she said.

While Bobko can't make the plane trip every time the boots need to be taken off, she said it shouldn't be an issue for Fossil Rim staffers.

"It's not complicated to take the boots off and put them back on properly," she said. "You line the front of the boot up with the zipper at the middle toe. You can just take antibacterial soap, wipe the boots down and then air-dry them."

Coco gets booted

Flash forward to Nov. 30, and Bobko was back at Fossil Rim with the aforementioned orange boots. With a slightly different, and smaller, cast of characters on scene, it was time to sedate Coco and put her boots on. The weather had cooled considerably from mid-October, so she was sedated inside the rhino barn as opposed to an outside pen.

"Compared to the sedation the first time Christine was here, I desensitized Coco to be locked in the barn at night for two weeks leading up to this procedure," Smith said. "It reduced the amount of stress on Coco significantly and allowed the procedure to be done regardless of the weather outside."

Before the boots went on, Haefele and the animal health personnel underwent a similar routine to Coco's last sedation, but with some variations such as an even more thorough cleaning of her front feet. "We were more aggressive in cleaning and trimming (the wounds) this time because we knew we'd be putting boots on, so we asked Dr. Dustin Dorris, an equine vet from Stephenville, to join us," Haefele said. "He actually worked on Coco back in 2009 when we treated her right front foot aggressively. His specialty is working on feet, so we requested for him to come out."



Fossil Rim staff and colleagues work diligently to complete the task at hand.



After Dr. Lisa Stephens, a Weatherford-based equine vet, prepares the angle of the portable x-ray machine and then steps away, Justin Smith, senior animal care specialist – hoof stock, and Dr. Holly Haefele (right), director of animal health, take an x-ray of Coco's foot. Haefele wanted to verify that a wound on the bottom of the foot hadn't resulted in a bone infection

While the wound on her left foot had become deeper since October and required extensive trimming, the wound on her right foot was now shallower. "We don't know why she continues to have problems, but it's interesting that the two trouble spots are in exactly the same area on each foot, which makes you think that area receives the most pressure when the animal is standing," Haefele said. "We don't see on the x-rays that there is (a foreign object) in there."

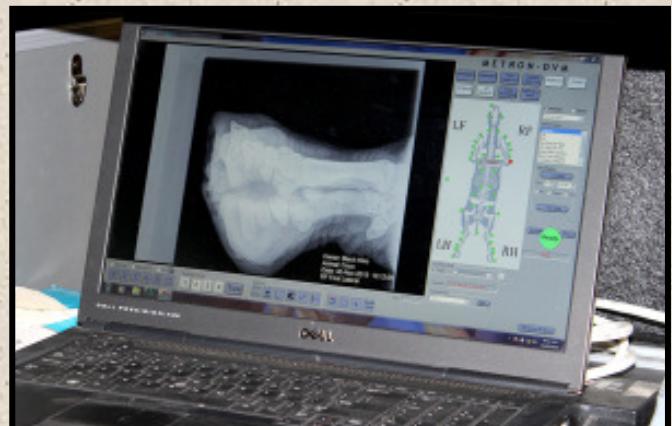
After all medical procedures were done and bandages applied, Bobko put each boot on and Coco was revived in order to try out her new footwear. "I was really pleased that putting on Coco's boots went very smoothly," Bobko said. "She has a much bigger (front) foot than the (back) foot of Mshindi, which was an eastern black rhino. This was our first time dealing with front feet, so there were additional considerations because we didn't want to impede the natural gait she has in her front feet while keeping her weight equally distributed. It was challenging, for sure, but when she trotted with the boots on I could see she was able to flex naturally."

If Coco would just keep the boots on through the first night, Bobko liked the chances of the boots making it the desired two weeks before they were to be removed for cleaning of feet and boots alike.

"It comes down to durability," she said. "Coco is the first rhino we're targeting to wear the boots that long. You need something waterproof, breathable and durable. She's an outside rhino, so it will definitely be a good trial for these boots."

Haefele was also optimistic following the procedure.

"I'm really pleased with the boots," she said. "Coco seems less angry and actually came up to the fence later during procedure day and presented her foot to Justin like she's been trained to do, which is a good sign the boots may be helping her feel better. They've also stayed on, which is great news."



Immediately after an x-ray is taken of Coco's right front foot, it is displayed on the laptop screen for evaluation.

After partaking in a second rhino sedation at Fossil Rim, Bobko saw consistency in the procedure.

"Especially with such an endangered species, you're going to have everyone pulling together for the work we did on Coco," she said. "The Fossil Rim staff is experienced in immobilizations, and everyone knows their role, so you seamlessly fit in on trying to help. You don't want these large animals down for a long period of time, so you need well-oiled execution."

The synergy among those in the rhino barn didn't go unnoticed by Haefele either.

"The Fossil Rim team, of which I consider Lisa and Dustin honorary members at this point, is excellent," she said. "That latest procedure was slick, fast and everybody knew what they were supposed to do. Dr. Stephens and Dr. Dorris are very busy veterinarians, but they make time for us pro bono to come do this work, which is spectacular. Christine is making time to build the boots and flying down to participate, so we're fortunate to have such great partners in this."



Dr. Dustin Dorris applies a cleansing solution to the wound on Coco's left foot. During both immobilizations, tourniquets were applied to Coco's front limbs to concentrate antibiotics in those areas.



Dr. Dustin Dorris cleans Coco's right foot before bandages are applied and her Diceros Boots are put on. Although it was the original foot to sustain a wound, the right foot healed more successfully than the left since Christine Bobko's first visit.



Shortly before they are put to use, Christine Bobko shows the Diceros Boots that were constructed specifically for the southern black rhino Coco that suffers from open wounds in both front feet.



An eye on the future

Smith added to the contentment in the moments that followed Coco getting her boots on.

"I feel very fortunate to have gone to the conference in England and learned about Christine's project," he said. "Then, (senior staff members) Adam, Kelley (Snodgrass) and Holly supported my thought that this was the best thing for Coco. Christine came out to get a fit for the boots and now they are on the rhino. It's amazing, and I feel really good from the day-to-day care standpoint."

"I'm excited to see how they hold up. Seeing Christine's progress with a boot that can help many animals if it takes hold is very encouraging. Thanks to everyone who helped us with this, including the veterinarians Lisa, Dustin, Holley and Julie (Swenson), as well as the hoofstock staff and interns."

An equine vet told Bobko the "boots could revolutionize the treatment of pachyderms."

"Our niche in the market is a treatment boot, and we hope to expand into equine and canine boots," she said. "But rhinos are my passion, so I'm always going to be involved with them and hopefully this is a way to give back to them."

Speaking of giving back, these efforts may help Coco do so for the black rhino population.

"If infection ever reached the bone of her toe, we'd be in trouble because it's very difficult to heal," Haefele said. "So far, so good. If we can get her feet to heal, maybe she'll stand normally with even weight distribution. Coco has been a great breeding animal, so if we can get her feet feeling better, we'd love for her to get pregnant again."

Coco's new boots!