AAZK 2015 Conference Proceedings

42nd Annual
AAZK National Conference
St. Louis, Missouri • 2015

September 27-October 1, 2015

AMERICAN ASSOCIATION of ZOO KEEPERS

AMERICAN ASSOCIATION of ZOO KEEPERS

ST. LOUIS AAZK
American Association of Zoo Keepers

TABLE OF CONTENTS

- Click on the paper title view manuscripts

Lauren Augustine and Matthew Neff Smithsonian National Zoological Park

If The Shoe Fits…An In Depth Look at a Common Zebra's Hoof Injury Repaired Via Corrective Shoeing
Meaghan McCarthy Disney's Animal Kingdom

Golden Ambassadors: Using golden and golden-headed lion tamarins as ambassadors for conservation
Dr. Jennifer Mickelberg[1] and Kenton Kerns[2] [1]Zoo Atlanta and [2]Smithsonian's National Zoological Park

Confessions of an Ex-Curator: Strategies for Navigating the Career Transition from Keeper to Animal Manager
Denny Charlton Smithsonian's National Zoological Park

Thursday, October 1

A Keeper's View on Managing the Federally Endangered American Burying Beetle Nicrophorus americanus
Daniel Koch Saint Louis Zoo

"Rain Forest Review "A Natural Behavior Show
Jeannette Schwab Cheyenne Mountain Zoo

Female Aggression Dynamics and Hormone Fluctuations in Black and White Ruffed Lemurs
Alicia N. Marty & Patricia Parker Saint Louis Zoo & University of Missouri

Birds of a Feather Don't Always Flock Together: Training Southern Cassowary for Voluntary Injections in a Protected Contact Environment
Samantha Kaeser

Using a GoPro Camera to Enhance Animal Husbandry at Disney's Animal Kingdom
Nicholas Milone, Carlos Torrez Disney's Animal Kingdom

Animal Care Continuing Education Series for Success
Brian Williams Disney's Animal Kingdom

Training Nile Hippopotamus for Voluntary Blood Draw
Mark Hacker Adventure Aquarium

Evolution of the Hog Chute
Christina Eastwood Dallas Zoo

The Raven…Nevermore: Challenges in Training an Extremely Sensitive Raven
Jennifer Walsh National Aviary

Training Dominant Expressive Behaviors in a Social Group of Variable Flying Foxes and African Straw-Coloured Fruit Bats
Ellen Dreyer Brevard Zoo

Training Black Rhino for Rectal Ultrasound
Kevin Scotti Cleveland Metroparks Zoo

Rearing the World's Most Endangered Turtles

By:
Nathan Haislip, Facilities Manager and Lead Keeper
Cris Hagen, Director of Animal Management
Turtle Survival Center, Turtle Survival Alliance
Charleston, South Carolina

Introduction

The Turtle Survival Alliance (TSA) was established in 2001 in response to the "Asian turtle crisis" in which numerous species of turtles from throughout the Asian continent were rapidly vanishing due to exploitation for the food and pet trades and for use in Traditional Chinese Medicine. Initially, the TSA was an International Union for Conservation of Nature (IUCN) partnership and recognized as a task force for the Tortoise and Freshwater Turtle Specialist Group (TFTSG). The TSA has grown rapidly and in 2004 gained 501(c)(3) non-profit status. Working with zoos, aquariums, government agencies, universities, NGO's and private citizens has allowed the TSA to establish captive assurance colonies of a variety of turtle species, as well as *in situ* conservation programs in various countries throughout the world. One example is the extensive work being done in Myanmar.

In 2007, the TSA began aggressively fighting to save the endemic species of Myanmar, including the Burmese Star Tortoise (*Geochelone platynota*), which was functionally extinct in the wild. The TSA-Myanmar Program took a multi-faceted approach that included developing school-based education programs and involving local people in the research and monitoring of the species. The TSA now maintains an extensive captive population of several thousand Burmese Star Tortoises at three facilities in Myanmar and through efforts in partnership with the Wildlife Conservation Society, local government agencies, and the local community, the Burmese Star Tortoise was reintroduced into the wild in successful releases of several hundred animals occurring throughout 2013 and 2014. Another success story in Myanmar is that of the Burmese Roofed Turtle (*Batagur trivittata*), which is considered one of the top five most endangered turtles in the world with only a few dozen surviving individuals. Through nest protection, headstarting hatchlings at nearby facilities, and establishing assurance colonies, the Burmese Roofed Turtle population is beginning to increase. In 2015, 60 headstarted individuals had grown large enough to avoid predation by most animals and were released to supplement the dwindling wild population. As with the Burmese Star Tortoise, this program relies heavily on public education and illustrating the ecological role these turtles play. However, for many species of turtles, *in situ* efforts are not currently viable because of many factors such as a lack of suitable habitat for reintroduction or in the case of the Burmese Roofed Turtle the added threat of dam construction on rivers they inhabit which would result in nesting beaches being flooded.

Figure 1. Release of the Burmese roofed turtle into its native habitat. This initiative is heavily focused on involving local people in the efforts of saving these species. Photo Credit: Steve Platt

A Home Base Established

The TSA was presented with an opportunity to establish a conservation center within the United States to focus its captive management program on some of the most endangered turtles in the world. In 2013, a 50-acre tract of land was purchased outside of Charleston South Carolina that already had much of the needed

infrastructure, as it had been a veterinary clinic/animal rehabilitation center with a secondary focus of crocodilian conservation and breeding. The property came equipped with a functional veterinary hospital, conference room, and several large ponds to house groups of turtles, however this was nowhere near adequate for the number of turtles within the TSA's collection. About 300 turtles were being housed at the Savannah River Ecology Laboratory (SREL), under the management of the TSA's Director of Animal Management, Cris Hagen. In the coming months, these animals were gradually transferred to the new Turtle Survival Center (TSC) to become a part of the assurance colonies that were planned.

As is often said, build it and they will come, and this has indeed been the case. Since establishing the center in 2013, the captive population has grown substantially due to the overwhelming generosity of the turtle conservation community. Several private individuals with large collections of extremely rare turtles donated animals to the TSA and the population has grown so rapidly, it currently exceeds our capacity. In response to the accelerated growth of the survival center's population, the TSA decided to hire a Facilities Manager/Lead Keeper and an Operations Specialist to focus on enclosure construction and infrastructure, a registered Veterinary Technician to provide necessary medical support, and most recently a full-time Husbandry Keeper.

Increasing Capacity

In 2014, with the hiring of Nathan Haislip – Facilities Manager and Lead Keeper, the Turtle Survival Center underwent an extensive renovation and focused efforts on increasing capacity for the growing collection. The most significant project was the completion of the "*Cuora* Complex", a high-security outdoor area for Asian box turtle species, many of which are on the brink of extinction. The facilities crew worked tirelessly for months to get this complex ready for the 2015 spring breeding season. In total, more than 200 tons of dirt and sand were added to the above ground enclosures, along with 20 tons of mulch. The secure, aviary-style, frame consists of more than 5,000 lbs of steel and 6,000 lbs of heavy-duty wire which took over 100 hours to install. The frame and wire are secured at the base by an extensive, 40,000 lb concrete footer that will prevent any burrowing predators from entering the complex. Beneath the soil and mulch of each enclosure lies an extensive network of water pipes supplying fresh water to all ponds. Finishing touches to the complex were added in April including a network of sprinklers to provide on-demand rain, and a variety of edible plants that will provide shade and food for years to come.

Figure 2. Interior of the Sulawesi tropical greenhouse with a variety of edible tropical plants including 6 species of bananas. Photo Credit: Nathan Haislip

The Turtle Survival Center maintains several tropical species of turtles including the largest known acclimated captive group of Sulawesi Forest Turtles (*Leucocephalon yuwonoi*) in the world, as well as a large population of Forsten's Tortoises (*Indotestudo forsteni*). To accommodate these tropical species, a 30' x 96' greenhouse was erected in 2014, which also provides the opportunity to grow a variety of tropical fruits and other plants that would not normally grow in South Carolina. This allows food production for turtles year-round. Several existing areas were also upgraded this year including a hatchling rearing room. Previously, the space was usable but not optimized, and was difficult to house aquatic species due to the need of frequent water changes. The room is now equipped with an extensive recirculating system that will allow us to house numerous species of

aquatic turtles. The recirculating system sends water to the enclosures via a pump located in a centralized sump. This sump contains various biological and mechanical filtration media and a U.V. sterilizer to ensure enclosures are always receiving fresh, clean water. An egg incubation area has also been established. Some turtle species require different temperatures to produce males or females, whereas other species require a diapause, a condition where an egg requires a cooling period before it can begin normal development. Therefore, we can now accommodate for these complex incubation procedures.

When the property was acquired in 2013, there was limited fencing, and remnants of an out-dated security system. However, concentrating some of the world's most endangered turtles in one general location obviously requires an extra level of security. The Center now has an extensive array of security features including motion alarms, sirens, motion-activated lights, razor wire, electric fences, and guard dogs to ensure that the turtles are protected from potential threats including predators and theft. With the help of volunteers from the North Carolina Zoo, we were able to build a secure fenced area and kennel for the guard dogs that live on-site. Other projects completed in 2015 included the addition of two large paddocks to our Tortoise Barn for larger species such as the Black Mountain Tortoise (*Manouria emys phayrei*). These wooden-fenced areas will give the tortoises plenty of room to roam.

Community Support

With the establishment of the TSC, the community has responded graciously. Numerous companies around the country have stepped up to help us with our cause through much needed donations. Through our active social media pages, blog, member newsletter, and more; we are able to promote the support we have received from these companies and show our supporters how much their donations mean to us. Of considerable note are large donations of goods from companies like Centrex Plastics who donated over 100 large plastic tubs to help us house a large donation of Asian box turtles until their permanent homes can be constructed. Or Waring manufacturing that graciously donated a commercial food processor to help prepare the large amount of diets fed out on a daily basis. Our local community has embraced the TSC as well. The local Goose Creek Farmers Market and Limehouse Produce has regularly donated produce and the local horticulturists of the low country have contributed many plants that will provide shade and food for our animals for years to come. All of these donations have saved the TSC thousands of dollars that can be allocated towards preserving these species.

Figure 3. Worms are consistently donated by the great folks at DMF Bait Company. Our turtles truly love them. Photo Credit: Nathan Haislip

The TSA gives back to the community as well through education and outreach. TSA staff have been actively involved with a variety of conservation-based expositions exhibiting some of the variety of turtles housed at the center and educating the community about the plight of these species. School groups have also been a focus and a variety of groups have been able to visit the turtle center where they can see species that even many biologists have never seen before. Here kids not only interact with the animals, but begin to understand why a center, like the TSC, is so vital to saving these species.

Another facet of the community is the support received from zoos and aquariums across the country. The center relies heavily on an extensive network of volunteers for all aspects of animal care. Numerous groups and AZA institutions have sent volunteers to the center to provide assistance with larger construction projects, animal husbandry, medical procedures, etc. These relationships have helped the center to continue its rapid growth. Others have been able to support the TSC by raising funds or applying for grants to purchase needed supplies for the center. See Table 1 for a list of institutions that have provided support for the TSC in the past few years.

Figure 4. Volunteer crew from Riverbanks Zoo and Georgia Sea Turtle Center after a long day of concrete hide construction, husbandry, and more. Photo Credit: Cris Hagen

Conclusion

With the 2014/2015 fiscal year coming to a close, the Turtle Survival Center has seen a drastic change. After a few setbacks, the center is now off its feet and to a running start. We now have permanent homes for most of the >500 turtles currently house at the center; however the population continues to grow. As more rare turtle species are donated, the center stays in a perpetual state of catch up with the most limiting factor being funding. Although we are able to provide more than adequate temporary housing, building permanent outdoor enclosures is both costly and time-consuming. It is through the support of organizations like the AAZK chapters and AZA institutions that helps the Turtle Survival Center continue its mission to save turtle species from the brink of extinction.

Table 1. Many organizations have offered their support in various ways to help the TSC continue to grow whether through financial support or sending staff to assist in various projects and procedures. The list below shows the extensive support that the TSC has received from animal-related organizations.

AAZK Heart of Illinois Chapter	Houston Zoo
AAZK Puget Sound Chapter	International Animal Exchange
AAZK Roger Williams Park Zoo Chapter	Jacksonville Zoo
Abilene Zoo	Jenkinson's Aquarium
African Safari Wildlife Park	Kansas City Zoo
Akron Zoo	Lee Richardson Zoo
Americorp	Los Angeles Zoo
Aquarium and Zoo Facilities Association	Moody Gardens
Aquarium Innovations	National Aquarium in Baltimore
Audubon Zoo	National Zoo
Baton Rouge Zoo	New England Aquarium
Beardsley Zoo	North Carolina Zoo
Bergen County Zoo	Oklahoma City Zoo
Birmingham Zoo	Omaha's Henry Doorly Zoo
Brevard Zoo	Phoenix Zoo
Cameron Park Zoo	Point Defiance Zoo and Aquarium
Chelonian Research Foundation	Riverbanks Zoo
Cleveland Metroparks Zoo	San Antonio Zoo
Clyde Peeling's Reptiland	San Diego Zoo
Columbus Zoo	Sedgwick County Zoo
Dallas Zoo	South Carolina Aquarium
Desert Tortoise Council	St Louis Zoo
Detroit Zoo	Tennessee Aquarium
Dickerson Park Zoo	Turtle Conservation Fund
Disney's Animal Kingdom	Virginia Aquarium
El Paso Zoo	Virginia Zoo
Ellen Trout Zoo	Wildlife Conservation Society
Fort Worth Zoo	Wildlife World Zoo
Georgia Sea Turtle Center	Woodland Park Zoo
Henry Vilas Zoo	Zoo Atlanta

The Zoo Component during a Sixth Extinction: Collaborative Partnerships in Amphibian Conservation

By

Victor Alm, Zoological Manager

Oakland Zoo

Oakland, California

Abstract

Zoos have long been helping to preserve animal species from population decline and extinction. As we navigate through what many scientists predict is the sixth extinction, zoos are being called upon to participate in programs that help preserve species of many taxa, especially those in their own backyard. Nowhere is this need more prevalent than with amphibians. The AZA Amphibian Taxon Advisory Group put out a call to member institutions in their Declining Amphibian Regional Response Plan to dedicate space for amphibians facing crisis in North America. One of the frogs identified was the critically endangered mountain yellow legged frog species *Rana sierrae* (Sierra Nevada yellow-legged frog) and *Rana muscosa* (southern mountain yellow-legged frog). A high alpine species, they were once a very abundant vertebrate in their ecosystem. Sport fish and chytridiomycosis are leading causes of a 90 percent decline in numbers. Numerous strategies are being employed by federal and state agencies in California to recover these species which includes partnering with zoos. Oakland Zoo is one of several AZA institutions that have created space and formed partnerships to help address these strategies. The Oakland Zoo is gaining experience in husbandry of the local Sierra Nevada yellow legged frog while participating in the collection, headstarting, and research being employed to provide resistance to the threat of chytridiomycosis. These types of partnerships not only help amphibians such as the Sierra Nevada yellow legged frog but also highlight the unique capacities that zoos can offer to declining species of varying taxa.

Introduction

Over the past several decades the footprint of zoos in the arena of wildlife conservation and preservation has been evident and their unique infrastructure to support animals in crisis through husbandry expertise, captive space/program dedication, public outreach, and fundraising has made a huge difference to those species that have seen that focus. The Association of Zoos and Aquariums (AZA) recently featured an article in their October 2014 issue of Connect highlighting numerous examples of how AZA Zoos have been successfully confronting extinction through reintroductions, such as the American Bison, Black Footed Ferret, California Condor, along with maintaining insurance populations throughout their membership for many species that currently are not good candidates for reintroduction. An example of support through the public outreach capabilities of the zoo community was seen in the 2008 Year of the Frog campaign that highlighted the global decline and crisis facing the amphibian community. However, as time goes on and the threats to animal communities only increase and extinction rates rise, zoos need to

and will be called upon to do more. We should view these successes up to this point as a starting point to a broader campaign to confront the sixth major extinction crisis facing our planet.

Zoos are called to respond to the sixth extinction

There have been five mass extinctions throughout our planets history and all have been highlighted by a profound loss of biodiversity in a relatively short period of geologic time. Substantial evidence verifies that a mass extinction-level event is underway and that human causes such as population growth, habitat destruction, introduced species, the direct slaughter of animals, and climate change effects are to blame (Wake and Vredenburg, 2008; Bento, 2014). Furthermore, infectious diseases are emerging that are taking their toll on taxa that are already facing some of these intense stressors. No taxon group highlights this crisis and faces a higher risk of widespread extinction globally than amphibians (frogs, toads, salamanders, and caecilians). As a group one third of all known amphibian species are facing or heading to extinction and half are threatened or endangered from causes directly linked to humans or emerging infectious disease, such as the chytrid fungus (*Batrachochytrium dendrobatidis*) (Wake and Vredenburg, 2008; "Global Amphibian Crisis"). In response to this extreme crisis facing amphibians the zoo community has a chance to show their capabilities to give critical support and form partnership roles for many species in need. In 2008, the AZA Amphibian Taxon Advisory Group (ATAG) called on AZA Zoos to make a more serious commitment to amphibian conservation, especially those in their own backyard or regions. This commitment was generally outlined as making space to house regionally endangered/threatened amphibian species, pooling resources with other regional facilities, agencies, and programs to make regional conservation partnerships, providing education material/public outreach, providing varying levels of support (technical, physical, logistical, financial) to programs dedicated to amphibian conservation, helping to support/create amphibian conservation centers, and contributing to long term funding/support to priority programs, field research, and rescue operations. Given the limited resources of zoos and the habit of skewing those resources to species abroad versus those close to home the International Union for Conservation of Nature Species Survival Commission (IUCN/SSC) along with the ATAG prioritized 4 North American species/groups in the first phase of their Declining Amphibian Regional Response Plan. The Oakland Zoo presents an example of a facility that has responded to the ATAG call in relation to one of the priority species, the Sierra Nevada mountain yellow-legged frog (*Rana sierrae*) , and became part of a larger regional conservation partnership across the Sierra Nevada mountains to save one of the most critically endangered amphibian species in North America. To help understand the critical role zoos can play in helping the mountain yellow-legged frogs one should first looks at its history.

Mountain Yellow Legged Frogs

The mountain yellow-legged frogs consist of two high alpine species, both critically endangered, the Sierra Nevada yellow-legged frog (*Rana sierrae*) and the southern yellow-legged frog (*Rana muscosa*). The range of the Sierra Nevada yellow-legged frog was found from the Diamond Mountains/Northern Sierra Nevada Mountains south to the middle and southern forks of the Kings River. The range of the southern yellow-legged frog was found from the middle and southern forks of the Kings River south through the transverse/peninsular ranges (Knapp, 2012). Habitat use consists of high elevation mountain lakes, ponds, and streams. A communal species from egg, to tadpole, to adult they can be found congregating in large numbers along warm, rocky , shallow, open shorelines. It is thought that this is

done to help speed up growth during the summer months when they are not hibernating under ice or in rock crevices to maximize growth in their different life stages (Brown et al., 2014) Eggs are laid in dense tennis ball sized clusters, attached to submerged vegetation/rocks/undercut banks, and hatch within 15 to 20 days (Knapp, 2012). Tadpoles are among the largest of any North American species, will wait 1-4 winters before morphing, and after becoming a fully formed frog they will likely wait another several years before reaching sexual maturity. All told they are quite long lived averaging 10 to 14 years (Brown et al., 2014).

Historical data from the early 20th century described these frogs as one of the most common amphibian species in their habitat (Brown et al., 2014). As recently as the 1950s surveys still described them as an abundant and common species, with some reports reporting populations in their range in the hundreds and in some cases thousands. Since that time there has been a radical decline in population due to the introduction of non-native game fish (such as trout), decreased habitat connectivity and quality, and the emergence of the chytrid fungus. It is estimated that due to these three primary risk factors that over 90% of historical numbers range wide for both species has decreased and that remaining populations of both species are being found in isolated pockets with small numbers (<30). The small numbers of individuals in each population and their isolation is effecting how the greater population is interacting lowering the chances of dispersal and recolonization of suitable habitat after mortality events and speeding up/ increasing the chances local extirpation and loss of genetic diversity (Brown et al., 2014).

Conservation Options

Despite the daunting figures and stressors facing the mountain yellow-legged frogs, all hope is not lost. There are a range of conservation options and strategies being coordinated by a regional mountain yellow-legged frog recovery group led by the United States Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW). This recovery group seeks to address the main risk factors facing the mountain yellow-legged frogs and to use the most up to date science and techniques to try and save both species. The main risk factors being addressed are the mitigation of the effects of chytrid fungus, the control of non-native fish populations, and how to deal with the remaining small isolated frog populations.

Control of Chytridiomycosis

To understand the current state of the threat facing the mountain yellow-legged frogs one needs to look at the chytrid fungus, the chytridiomycosis disease it causes in amphibians and its spread across the majority of the mountain yellow-legged frog range. There are only a small number of areas where chytrid fungus is not yet present, such as a few remote areas of Sequoia Kings Canyon National Park and some areas of the Eastern Sierra Nevada (Knapp, "Unpublished Data"). Mountain yellow-legged frogs do not have an innate resistance to chytrid and it effects the frogs by attacking the keratinous areas of their skin causing it to harden, compromising their ability to transfer oxygen, other gases, and absorb key electrolytes leading to rapid mortality (Global Amphibian Crisis, Chytrid Fungus). It is important to note that not all amphibian species within the range are affected by chytrid fungus, such as the pacific chorus frog (*Psuedacris regilla*). Also, not all life stages of the mountain yellow-legged frog are affected by chytrid. The pacific chorus frog and the tadpole stage of the mountain yellow-legged frog themselves seem to have resistance to the disease, but can spread the fungus or set the stage to infect frogs when they go through metamorphosis into adults (Reeder et al., 2012; Biggs, et al., 2005). In the case of the mountain

yellow-legged frogs specifically it has been shown that the disease can be spread between life stages (Rachowicz and Vredenburg, 2004). Furthermore, their own communal nature as both tadpoles and adults, which has been so successful throughout their life history, is perhaps exacerbating the spread of the disease. However, there have been cases of long term population survival in the presence of chytrid. When researching this observation along with why some species of amphibians are resistant to chytrid and how the immune response in mountain yellow legged frogs occurs in different life stages one can see some options on how to combat the effects of this deadly disease.

The major hope in combating this epidemic and consequentially one of the major directions of research for the mountain yellow-legged frogs is to help them mount their own immunological defense against chytrid. One avenue of research is focusing on if the frogs can acquire an immune response to chytrid. It has been shown that it is fairly easy to absolve animals of chytrid in a captive setting using antifungals such as itraconazole (Garner et al., 2009). Also, acquired immune response has also been shown once cleared of chytrid and immediately after re-exposure to the disease in adult frogs; however, such a response seems to subside over time (Toothman, "Unpublished Data"). This immune response could be an important option to consider in combating chytrid as it is spreading into new areas of the frogs range. If timed right this type of treatment could buy populations just facing the spread of chytrid some time to develop an immune response (Ellison et al., 2014). One key factor of all this to consider is that it might only work with frogs that have already metamorphed. The tadpoles have already shown they can be chytrid reservoirs and resist the disease. However, when frogs metamorph they completely reorganize their immune system, making them especially susceptible to the effect of chytrid (Rollins-Smith et al., 2011). For this option to show any potential effects, time would need to be allowed for in post-metamorphic frogs in order for them to develop a more mature immune system.

A second avenue of research looks into the antifungal probiotic treatments on the skin of the frogs. This line of research looks into the microflora of amphibian skin and how it interacts with disease organisms such as chytrid. It has been found that an anti-fungal bacteria such as *Janthinbacterium lividum* have been found in higher concentrations in the skin microflora inhibiting the growth of the fungus in species such as the red-backed salamander and in surviving pockets of mountain yellow legged frogs (Woodhams et al., 2007). Bioaugmentation of the frogs skin using anti-fungal bacteria has been tested as a strategy to control the chytrid and increase survivorship and some success has been seen (Harris et al, 2009). Similar to the use of anti-fungal agents such as itraconazole, the probiotic treatments would need to be timed and employed on adult frogs when chytrid is entering/emerging in a population, as the resistant effects can also subside over time (Vredenburg, "Unpublished Data"). If employed too soon the effects of the bioaugmentation will subside prior to chytrid arriving, and if too late the effects of chytrid will be too advanced to help the population survive.

Control of Non-native predation

Prior to the emergence of the chytrid fungus the introduction of non-native game fish such as golden, rainbow, brook, and brown trout were a leading cause of declining frog numbers across their range. Trout are aggressive aquatic predators and consume all the life stages of the mountain yellow-legged frog from egg to adult. It has been shown that through both alteration of stocking practices and the removal efforts of these fish that suitable habitat can be restored and frog numbers can rebound (Knapp et al., 2007). However it needs to be considered that in a landscape now dominated by chytrid that the effects

of fish removal on frog populations will vary on whether that removal occurs in a chytrid positive or chytrid negative area. Although extirpating trout is a removal of one major stressor on frogs, their survivability would probably only increase slightly as any frogs dispersing, translocated, or reintroduced to the area will still have to contend with the fungus.

Small, isolated populations

As mentioned above in the section discussing the history and decline of the mountain yellow-legged frog that due to the decline and isolation of frog populations across the range there is a greater risk of extirpation of these remaining populations as well as loss of the genetics they represent. Recruitment of adult frogs into these populations as well dispersal of adult frogs to recolonize good quality habitat are important considerations to address in any strategy to increase mountain yellow-legged frog numbers. Translocation of frogs can be and is a major tool to address this. By moving frogs from populations that are overall doing well or better than others, one can help overcome the loss of connectivity between suitable habitats. There has been proven success with this in chytrid negative areas; however there has not been success in chytrid positive areas and overcoming the challenge of recruitment remains.

Zoos can play a valuable role to aid in the recruitment bottleneck caused by chytrid and other factors such as predation by both native and non-native animals. Zoos can use their available space and expertise in captive amphibian husbandry/research to aid in recovery efforts. In the case of the mountain yellow-legged frogs they can provide the opportunity to captive rear or headstart vulnerable life stages, such as eggs, metamorphs, and young frogs, and help them reach adulthood. Once they are of suitable size and age to be returned they can undergo treatments to increase resistance to chytrid and increase survivorship. This can be very important in populations where few adult frogs remain and there is no recruitment. Several zoos such as San Diego Zoo, LA Zoo, and San Francisco Zoo are already involved in recovering the mountain yellow legged frogs and their successes have prompted the inclusion of captive rearing and headstarting as part of the overall conservation strategy. However, there is still a great want and need for more involvement from the zoo community, especially from those facilities that are housed in the range of the frogs.

Captive Rearing - Oakland Zoo Joins the Fight

In 2014, with the help of a major grant from the California Cultural and Historical Endowment along and anonymous donor, the Oakland Zoo opened the doors to its Biodiversity Center, answering the need for more zoo involvement in regional mountain yellow-legged frog recovery as well as the call to action by the ATAG. The Oakland Zoo renovated its old veterinary clinic into a center dedicated to amphibian conservation, an important step towards addressing the crisis facing the mountain yellow-legged frog. Primarily focused on the Sierra Nevada yellow-legged frog the Biodiversity Center has several dedicated independent quarantine labs, varying equipment, and reverse osmosis water systems that allow the Zoo the ability to concurrently house different life stages (adults, metamorphs, tadpoles, or eggs) as well as chytrid positive and negative animals. The current plan for the Oakland Zoo is to hold individuals for headstarting, support field/lab research through staff involvement, and build capacity over the next several years to be an active, growing, and impactful contributor to a regional group that is dedicated to the Sierra Nevada yellow-legged frog. That group led by the USFWS and CDFW consists of the San Francisco Zoo, San Francisco State University, The Sierra Nevada Aquatic Research Lab, the National Parks Service, the US Forest Service, along with other agencies. It is the purpose of this group to meet

about, facilitate, coordinate, and accelerate actions to recover the mountain yellow-legged frog across its historic range in the Sierra Nevada.

In 2013 the Oakland Zoo during the final construction phases of the Biodiversity Building featured the mountain yellow-legged frogs and the research by the Vredenburg Lab of San Francisco State University in its Quarters for Conservation Program. This program not only brings public awareness to the recovery efforts surrounding the mountain yellow legged-frogs but uses a portion of every admission fare to go towards a set of conservation projects and efforts voted upon annually by the staff of the Zoo ("Saving Wildlife with Each Visit")

In 2014 the Biodiversity center took in 26 adult Sierra Nevada Yellow legged frogs representing the genetically valuable populations of Marmot Lake, Ebbetts Pass, and Dusy Basin. The Marmot Lake and Ebbetts Pass populations no longer have frogs remaining and the Dusy Basin population only has a small number remaining. By housing these legacy populations the Zoo will be ready to breed them if the call is made. In addition to the adult frogs, the Zoo received chytrid positive tadpoles from Big Pine Lakes in the Inyo National Forest with the intent to clear these individuals of chytrid, headstart to adulthood, and return to source populations if based on the needs of the species is recommended by the group at that time.

In 2015, Oakland Zoo is set to bring in eggs or tadpoles from either the Tyndall or 60 Lakes basin populations found in Sequoia Kings Canyon National Park in collaboration with San Francisco Zoo, clear them of chytrid if necessary, headstart them to adulthood, help increase their resistance to chytrid, and return to their source populations if decided. Furthermore, space is being dedicated to respond to any emergency recovery situations during the summer season to a refuge space as needed, determined by biologists in the field.

Amphibian Conservation Partnerships

A partnership is defined as an arrangement where known parties, known as partners agree to work together or cooperate to advance a mutual interest. In the case of the mountain yellow-legged frogs of the Sierra Nevada the partnership that has developed between the involved parties is to facilitate, coordinate, and accelerate actions to recover the mountain yellow-legged frog across its historic range in the Sierra Nevada. There are many benefits to this multi-disciplinary regional partnership that includes the exchange of information, expertise, funds, support, and staff time of all stakeholders involved. There is also the pride and excitement of working to save a unique and irreplaceable animal that is an integral part of California's heritage. However, despite all the apparent advantages there are still questions and challenges surrounding zoo involvement. Questions such as if captive-reared animals can be successfully reintroduced into chytrid positive areas, can enough animals be brought to adult stage through headstarting to be effective against predation, are funding sources for conservation of frogs in captivity stable enough to allow for long term partnerships and holders. Some of these answers will take time to study and get results along with time to get past old stereotypes of what the role of a zoo is and should be. Ultimately it is the success stories that will speak the loudest. Both the San Diego Zoo, with the southern yellow-legged frog, and the San Francisco Zoo, with the Sierra Nevada yellow-legged frog, have effective husbandry practices that overall result in high percentages of eggs or tadpoles making it through the morphing process. Their successes in captive rearing/headstarting, and their willingness to share their husbandry practices and staff expertise help pave the way for facilities such as the Oakland

Zoo and others to be active and engaged partners in the fight to save their local endangered species. Furthermore, this type of multi-disciplinary partnership surrounding the mountain yellow-legged frog, and the recommendations and actions that come from it, can serve as an example and help form a framework to create long-term conservation strategy that over time will make a real difference to combat the amphibian crisis.

Conclusion

The Oakland Zoo and a group of other zoos are providing much needed space, captive husbandry rearing expertise, and public awareness to help promote the recovery of a frog species that not only represents the global amphibian crisis, but that of the sixth great extinction event facing our planet. In 2014 the American Association of Zoos and Aquariums launched their SAFE (Saving Animals from Extinction) program. It is the goal of this program to bring together scientists, stakeholders, and their own membership to develop and move forward actions plans that identify threats, raise resources for, and engage the public to support local conservation efforts. Long gone are the times where zoological institutions should be viewed as just a menagerie of animals that are captured from the wild and put on display to entertain the public with no regards to the welfare of the animal species they houses and their wild counterparts. The modern day zoo has evolved from its historical roots into centers of public education, global conservation of wildlife, research, and animal welfare. It is no wonder that more and more zoos and their expertise in animal care are becoming involved as desired stakeholders in complex conservation partnerships to save animals from extinction. One such example that can highlight the unique capacity that zoos, such as the Oakland Zoo, have to offer is that of the mountain yellow-legged frogs in the Sierra Nevada. The zoo component in regional partnerships alongside government agencies, the scientific community, and NGOs is growing and should be included in the conservation framework of varying taxa that are in need.

References

Association of Zoos & Aquariums. (2008). Year of the Frog – Global Amphibian Crisis Fact Sheet. Retrieved from http://www.aza.org/year of the frog.

Barber, D.; Snider, A.; Hall, G.; Johnson, B.; Spencer, B.; Foster, B.; Krebbs, J.; Berg, C.; Crump, P. (2006). AZA's Amphibian Taxon Advisory Group Declining Amphibian Regional Response Plan Phase One: North America. Pages 1-27.

Bento, M. (2014, October). Zoos and Aquariums Confront the Extinction Crisis. Connect. Pages: 8-13.

Biggs, C.J.; Vredenburg, V.T.; Knapp, R.A.; Rachowicz, L.J. (2005). Investigating the population level effects of chytrdiomycosis: An emerging infectious disease of amphibians. Ecology 86 (12): 3149-3159.

USDA. Brown et al. 2014. Mountain Yellow-Legged Frog Conservation Assessment for the Sierra Nevada Mountains of California, USA. Report of the USDA, an inter-agency project. RS-TP-038: 1-138.

Chytrid Fungus. Amphibian ark. Retrieved from http://www.amphibianark.org/the-crisis/chytrid-fungus

Ellison, A.R.; Savage, A.E.; DiRenzo, G.U.; Longhammer, P.; Lips, K.R.; Zamudo, K.R. (2014). Fighting a losing battle: Vigorous immune response countered by pathogen suppression of hose defenses in the chytridiomycosis susceptible frog *Atelopus zeteki*. G3. doi: 10.1534/g3.114.010744

Garner, T.W.J.; Garcia, G.; Carroll, B.; Fisher, M.C. (2009). Using itraconazole to clear *Batrachochytrium dendrobatadis* infection, and subsequent depigmentation of *Alytes muletensis* tadpoles. Diseases of Aquatic Organisms V83: 257-260.

Harris, R.N; Brucker, R.M.; Walke, J.B.; Becker, M.H.; Schwantes, C.R.; Flatery, D.C.; Lam, B.A.; Woodhams, D.C.; Briggs, C.J.; Vredenburg, V.T; Minbiole, K.P.C. (2009). Skin microbes on frogs prevent morbidity and mortality caused by a lethal skin fungus. International Society of Microbial Ecology: 1-7.

Knapp, R.A.; Boiano, D.M.; Vredenburg, V.T. (2007). Removal of non-native fish results in population expansion of a declining amphibian (Mountain Yellow-Legged Frog, *Rana muscosa*). Biological Conservation 135: 11-20.

Knapp, R. A. (2012). Natural History Distribution. The Mountain Yellow-Legged Frog Site. Retrieved from http://www.mylfroginfo.

Knapp, R.A. The spread of Batrachocytrium dendrobatadis across the range of the mountain yellow-legged frog. Unpublished Research

Lam, B.A.; Walke, J.B.; Vredenburg, V.T.; Harris, R.N. (2010). Proportion of individuals with anti-Batrachochytrium dendrobatadis skin bacteria is associated with population persistence in the frog Rana muscosa. Biological Conservation 143: 529-531.

Rachowicz, L.J. and Vredenburg, V.T. (2004). Transmission of *Batrachochytrium dendrobatadis* within and between amphibian life stages. Diseases of Aquatic Organisms V61: 75-83.

Reeder, N.M.; Pessier, A.P.; Vredenburg, V.T. (2012). A reservoir species for the emerging amphibian pathogen *Batrachochytrium dendrobatadis* thrives in a landscape decimated by disease. Proc Natl Acad Sci USA V7 I3: 1-7.

Rollins-Smith, L.A.; Ramsey, J.P.; Pask, J.D; Reinart, L.K.; Woodhams, D.C. (2011). Amphibian immune defenses against chytridiomycosis: impacts of changing environments. Integrative & Comparative Biology. doi: 10.1093/icb/icr095.

Saving Wildlife with Each Visit. Conservation & Education Oakland Zoo. Retrieved from http://www.oaklandzoo.org/Quarters_4Conservation.php

Toothman, M. Immune response of mountain yellow-legged frog in response to *Batrachochytrium dendrobatadis.* Unpublished Research.

Vredenburg, V.T. The long term effects of anti-fungal skin microbes on preventing mortality from *Batrachochytrium dendrobatadis.* Unpublished Research.

Wake, D.B. and Vredenburg, V.T. (2008). Are we in the midst of the sixth mass extinction: A view from the world of amphibians. Proc Natl Acad Sci USA 105(Suppl 1). Pages 11466-11473.

Woodhams, D.C.; Vredenburg, V.T.; Simon, M.A.; Bullheimer, D.; Shakhtour, B.; Shyr, Y., Brigss, C.J.; Rollins-Smith, L.A.; Harris, R.N. (2007). Symbiotic bacteria contribute to innate immune defenses of the threatened mountain yellow-legged frog, *Rana muscosa*. Biological Conservation 138: 390-398.

Acknowledgements

I would like to acknowledge several people and groups that have been critical in the Oakland Zoos involvement in the work with the Sierra Nevada yellow-legged frog. A big thanks to Vance Vredenburg (San Francisco State University), Roland Knapp (Sierra Nevada Aquatics Research Lab), Laura Patterson (California Department of Fish and Wildlife), Dave Kelly (United States Fish and Wildlife Service), Colleen Kinzley (Oakland Zoo Director of Animal Care, Conservation, and Research), Dr. Joel Parrott (Oakland Zoo Executive Director), the Biodiversity Building Team (Margaret Rousser, Darren Minier, Adam Fink, Ashley Terry, Miero Wakeman, Carol Wing, and Kyla Balfour), Amy Gotliffe (Oakland Zoo Conservation Director), Jessie Bushell (San Francisco Zoo), Frank Santana (San Diego Zoo Global), Ian Recchio (LA Zoo), and the numerous others in the United States Fish and Wildlife Service, California Department of Fish and Wildlife, National Parks Service, and United State Forest Service that have spent their time dedicated to saving the mountain yellow-legged frog from extinction.

Taking Raptor Ecology of the Shrub-Steppe from the Field to the Zoo

Susan Burchardt, zookeeper

Gretchen Albrecht, zookeeper

Fred Koontz, Vice President of Field Conservation

James Watson, Wildlife Research Scientist, WDFW

Woodland Park Zoo

Seattle, WA

Abstract

Woodland Park Zoo (WPZ) and Washington Department of Fish and Wildlife (WDFW) work together on raptor conservation in Washington State by collaborating on research and public education. The zoo's "Raptor Ecology of the Shrub-Steppe Program" since 1999 has supported zookeepers, trained by WDFW scientists, to collect field data addressing raptor ecology and conservation. Zookeepers are able to spend time in the field gaining first-hand knowledge of raptor issues, empowering them with information to better inform zoo visitors. Keepers have assisted with trapping, nest surveys, observations, and comparing migration patterns of Ferruginous Hawks (*Buteo regalis*). Most recently, keepers and WDFW biologists have collected data on interactions of nesting buteos with wind turbines. Based on their field experiences, the zookeepers inform large numbers of the zoo's 1.2 million annual guests about raptor conservation and related public policy issues through education programs, including a daily raptor flight presentation featuring birds from Washington's declining shrub-steppe habitat. Additional information is provided to the public through WPZ's "Living Northwest" field conservation program, website, and on-site kiosk. Using evaluation metrics, the zoo's Education Department quantifies the impact zookeepers are having on audiences. Data from these metrics and additional details of the collaborative WPZ and WDFW raptor conservation work will be presented.

Introduction

Woodland Park Zoo (WPZ) has a long history of working with the Washington Department of Fish and Wildlife (WDFW) on raptor related issues, originating with eagle rehabilitation, release and tracking. When that project ended in the early 1990's raptor keepers wanted to continue the partnership so in 1999 they joined with state raptor biologist, James Watson, to create Raptor Ecology of the Shrub Steppe. This mutually beneficial partnership has been an opportunity to support Fish and Wildlife both financially and with hands-on assistance in the field.

The project first focused on ferruginous hawks, a Washington state threatened species which is dependent on good quality shrub-steppe. Shrub-steppe habitat is an underappreciated habitat in Washington. It's an iconic western landscape of sagebrush plains, rimrock and tumbleweeds which features layers of perennial grass with a discontinuous overstory layer of shrubs which has historically dominated eastern Washington. Southeastern WA is the northern part of the ferruginous hawk's breeding range. They are migratory in our state and when we started the project very little was known about their migration. Using satellite telemetry we were able to get detailed information about their movements and migration. Over four field seasons 26 hawks from Benton and Franklin counties were tracked. It was notable that several

of the hawks crossed the Rockies before heading south, perhaps to exploit their favorite food, ground squirrels. We also assisted with nest surveys to help determine occupancy and productivity.

In 2004 we expanded the project to include a nest camera. At the time it likely was the only ferruginous hawk nest camera online. Jim Watson placed this nest camera on the power structures at the Hanford Site, a mostly decommissioned nuclear production complex. These nests often blew down over the winter so he also introduced a pre-made nest platform. From 2004-2007 hawks were in attendance at this site, but the nesting success was hit and miss. Jim reviewed the footage and we showed highlights on the zoo's website. The nest camera gave us a wonderful, intimate look at the nesting cycle of these secretive hawks. It also gave us some new and interesting information: reptiles were part of the diet, as were grasshoppers. Unfortunately one year one of the chicks didn't survive; the parents fed it to its siblings.

As will happen with a declining, migratory species, in 2008 the male returned to the nest but the female did not return. He was unable to recruit a new female and a red-tailed hawk was also seen in the nest. The nest was not active that year. In 2009 a 2nd nest camera was added; ravens had taken over the first nest, but again a male returned to the nest with no female in attendance. The second nest was not active. That was the last year of the ferruginous hawk nest camera.

Assisting with this field work was a great experience for the keepers but we needed to bring it to the zoo guests as well. The foundation of the WPZ's Raptor Center is its free flight program where we highlight Washington's native raptors. This flight program is attended by thousands of zoo guests every year. In 1999, to complement the Raptor Ecology of the Shrub Steppe program we acquired a ferruginous hawk as an addition to the flight line up. She's a spectacular bird and has been thrilling zoo visitors ever since. The flight program is an obvious place to discuss the partnership of the zoo and Fish and Wildlife and more importantly to share the struggle of Washington's shrub-steppe habitat and the wildlife that depends on it.

The project was also shared in outreach programs locally in the Seattle area and in eastern Washington through Wildwise, which was offered free of charge, statewide. The project was and still is highlighted on the zoo's website. During the migration tracking, maps following individual migration routes and activities were posted which teachers could use in the classroom. In the later years of the nest camera we had a kiosk installed at the Raptor Center which showed the nest camera live and for years after the camera went offline we showed highlight clips and had graphics regarding the project. We always referred to it during the flight program as a place guests could get more information.

Going forward, Washington Department of Fish and Wildlife and Woodland Park Zoo now have three major areas of interest in the research. The first is blood sampling and lead analysis in golden eagles. The second is collecting diet information on golden eagles for sources of lead. The third is buteo interactions with wind turbines.

For the lead study Fish and Wildlife biologists trap the eagles and take blood samples. WPZ provides funding for the samples to be analyzed. The analysis uses isotopes to evaluate what kind of prey was eaten, differentiating ungulates from birds and rodents. The isotopes also identify the origin of the lead, including which brand of bullet or pellet it came from. Lead poisoning is an issue that resonates well with zoo guests.

In addition, WDFW has installed three nest cameras purchased with zoo funding on golden eagle nests to assess potential sources of lead contaminants. The prey delivery information can be linked to flight locations to pinpoint where prey was captured and identify prey habitats.

In the wind power study Jim identifies the buteo nest sites we will be addressing each year and over the course of two to three weeks four or five zookeepers spend their days observing the nest sites, the surrounding wind project and recording any time a raptor comes within four hundred feet of a turbine. In a typical observation we keep the scope on the nest and use binoculars or naked-eye observation to follow the bird through the interaction zone. We simultaneously record wind speed and direction and the speed of the turbines. Over the first three years of the study we recorded four hundred thirty four hours of observations. This data will allow us to quantify the behavior of hawks flying around turbines to understand the rates of exposure to collision and whether they avoid turbines at some distance.

We're really fortunate to bring what we see in the field to our guests at the zoo. Not only do we continue to have a world-class flight program, we also bring these birds and our observations to elementary and secondary-age kids through specialized programs designed with our education department. The zoo's Master's degree level AIP program has classes in eastern Washington also. Many of the students in that program are school teachers so we get the multiplier effect of them passing on what they've learned to their students.

We've developed new artifacts and graphics to highlight our conservation work and to make it a little more real and present for zoo guests. Woodland Park Zoo has developed a program where zoo attendees receive a portion of their admission back, as a token, which they can then direct toward a conservation program that speaks to them. We refurbished the kiosk and are bringing it back as a more interactive portal for guests to engage with. In an additional effort to disseminate what happens in the field to as wide an audience as possible, we write a mid-summer blog post that goes out to all those who follow the zoo on social media.

We are fortunate to be one of few zoos with full-time staff evaluating our audience and messaging effectiveness. WPZ's Raptor Center presents programs to 46000 guests annually. We try to be as specific as possible in tying actions to species and projects and check which action items people remember, both immediately after a presentation and several months later. For example, in one poll 48% of respondents remembered that one of the messages was "Do not use lead shot/Tell friends to switch ammo."

The mission of zoos has changed over the years from facilities that focused on breeding and exhibiting exotic animals to places of education and conservation. Today Woodland Park Zoo, like many zoos, commits much time and energy to conservation projects around the world. We have a fully-staffed conservation department and spend well over $1 million per year supporting conservation programs. Recently the Conservation Department reorganized its programs to streamline and better serve the needs of each. This will help to ensure that the resources the zoo has to offer are used as effectively as possible. Raptor Ecology of the Shrub Steppe is now part of the Living Northwest grouping which contains programs specific to the Pacific Northwest. Living Northwest leverages zoo-based resources to carry out and support Pacific Northwest wildlife conservation projects, including Western Pond Turtles, Oregon Spotted Frog, Oregon Silverspot Butterfly and Barn Swallow Migratory Ecology among others. This program will set the stage for our zoo to take a more proactive role in tackling our region's most pressing conservation issues.

Our goals moving forward are to narrow down sources of contaminants and learn how and if raptors avoid wind turbines. We hope to better inform wind turbine siting to reduce hawk collisions and displacement. Our goals at the zoo are to help the public connect to a couple of key ambassador animals and hopefully, through those connections and by providing guests with actionable items, get them excited about the shrub-steppe.

2015 AAZK's BOWLING FOR RHINOS
"Making a Difference with AAZK's Bowling For Rhinos"

Presented by Patty Pearthree
National Bowling For Rhinos Program Manager

Introduction

The American Association of Zoo Keepers (AAZK) "Bowling For Rhinos" (BFR) fund-raiser has raised over **$5.6 million** since 1990 entirely through volunteer efforts. It is the hard work and dedication of these volunteers that make the difference in wildlife conservation efforts. 2014 was another record breaking year raising over $581,000 for conservation worldwide! In Kenya, we now protect over 1.5 million acres of white and black rhino habitat under Lewa's conservation charter. In Indonesia, we protect 1.4 million acres of crucial lowland rainforest habitat for the survival of the Javan and Sumatran rhinos and other species living in their ecosystems including Sumatran tigers, elephants, tapirs, Javan gibbons and sunbears. AAZK's BFR supports ALL 5 species of rhino plus hundreds of other endangered species from orchids to elephants that live in their habitat. Had it not been for organizations like AAZK many of these species would not be around today. AAZK has made a difference and will continue to do so.

Accomplishments through Our Conservation Partners

Our support of these conservation partners has allowed us to come together in conservation to help change the world. Black rhino were only one of a number of species that were likely to go extinct by the year 2000 had it not been for AAZK's BFR support. Black rhino have doubled to around 5,000 in number with BFR support. In 1990 we protected wildlife in Lewa's 10,000 acre Ngare Sergoi Rhino Sanctuary. We now protect 3 million acres of wildlife habitat. That is 25% larger than Yellowstone National Park! All this comes at a price. Operation costs to protect wildlife in these areas increases at 10-15% per year. Combined with the ever increasing poaching pressure, this means we need to increase our overall dollars raised. We have made a huge difference but our challenge is to keep growing bigger & better each year so all this can be saved for future generations. For additional information on rhino conservation, visit: www.rhinos.org and www.lewa.org

Together in Conservation

The best conservation programs involve long-term commitment. Since 1990, AAZK's Bowling For Rhinos has been one of the world's most successful conservation programs raising over $5.6 million for conservation worldwide! AAZK remains committed to its conservation partners: Lewa Wildlife Conservancy (LWC), International Rhino Foundation (IRF) and Action for Cheetahs in Kenya(ACK). 100% of BFR funding is being spent on conservation programs with 98% being designated specifically for conservation projects within rhino habitat. The remaining 2% of uncommitted funds is weighted heavily to favor rhino conservation programs and has now allowed us to support the conservation programs of the Indian rhino.

We started out supporting Lewa Wildlife Conservancy in Kenya- called Ngare Sergoi back in 1990 when it was 10,000 acres. AAZK paid for fencing, surveylance airplanes, transport trucks,etc. in the early years but have since moved to supporting the toughest to fund item- operating costs. Lewa's operating cost is now $3.3 million annually and Lewa is 72,000 acres. Lewa also now manages the 90,000 acre neighboring conservancy called Ol Pejeta. Rhinos disappeared from this area in the 1970's but Lewa reintroduced 15 black rhino in 1984. Lewa is now home to 12% of Kenyas Black rhino population and 14% of the white rhino population and several rhino have gone to other areas to repopulate. OL Pejeta is home to 88 black rhino, 11 Southern White Rhino and 3 of the last remaining Northern White Rhinos on the planet! 12 black rhino were moved to the neighboring Borona Conservancy. This was a longtime dream of Lewa staff that finally became reality in 2012. Lewa is now a globally recognized conservation initiative.

Lewa's **core** rhino conservation program has always been the main focus of BFR funding. AAZK contributes about 15 % of the core operating costs of this annually. These funds are vital to rhino conservation and the survival of the species. AAZK's long term and continuous funding makes it an invaluable contributor to the success of LWC in conservation worldwide!

In 2013, Lewa Wildlife Conservancy became a UNESCO World Heritage Site and is part of the area called **Mount Kenya World** Heritage **Site**. This unique recognition is reserved "for places of outstanding universal value to humanity that, as such, have been inscribed on the list to be protected for future generations to appreciate and enjoy". The World Heritage Committee considered Lewa and Ngare Ndare for their outstanding natural beauty, as well as their varied and impressive ecosystems and biodiversity. Lewa and Ngare Ndare are all connected to Mount Kenya through an elephant corridor. Lewa was instrumental in the creation of this crucial migration passage that serves as a route for landscape connectivity.

Expanding Support to Indonesia
In 1994, AAZK expanded its funding efforts when it began supporting Ujung Kulon National Park in Java Indonesia to save the Javan rhino. Ujung Kulon is home to the last 25-45 Javan rhinos on earth. AAZK expanded its funding efforts once again in 1997 to include Bukit Barisan Selatan National Park (BBS) in Sumatra, Indonesia where one of the largest populations of Sumatran rhinos live. Only about 100 Sumatran rhinos remain, and because of their rapid rate of decline, they are considered the most threatened of all rhino species. All of our funding for the Indonesian rhino Programs now goes through IRF.
Currently, the IRF funds allow the operation of rhino protection units in Ujung Kulon National Park (NP), Way Kambas NP & Bukit Barisan NP. Thanks to these Patrol units there have been no cases of Rhino or large mammal poaching in Way Kambas since 2006, Bukit Barisan since 2001 and Ujung Kulon in at least 15 years! With less than 100 Sumatran & perhaps as few as 25 Javan rhino remaining, these Patrol units are vital to the survival of both species.

Action For Cheetah in Kenya
In 2009, AAZK's BFR began supporting ACK under the direction of Mary Wykstra. This support will add to the protection of not only cheetah but also Rhino through education and conservation of habitat that is home to both cheetah and rhino and creates a larger buffer zone of protection. See www.actionforcheetahs.org

AAZK Conservation Resource Grant Helps Save All Five Species of Rhino
Each year, the AAZK Conservation Resources Grant is awarded to an ex-situ or in-situ rhino conservation effort. In 2010 and 2011, IRF was awarded the AAZK Conservation Resources Grant of 2% of the balance of BFR funds raised. Funds provided radio collars for Indian Rhinos that were being translocated as part of the Indian Rhino Vision 2020 Program. This program aims to attain a population of 3,000 wild rhino in seven of Assam's protected areas by 2020. So now **BFR funds support all five species of rhino!**

AAZK Working To Halt Demand for Rhino Horn
The 2013 and 2014 Conservation resource grant supported a new organization, RhiNOremedy that works to put an end to the demand for rhino horn, elephant tusks and other illegal wildlife trade products. See http://www.rhinoremedy.org/ for more information.

Zarraffas Coffee of Australia Pledges Sponsorship
Since 2013, Zarraffas Coffee of Australia (the "Starbucks of Australia") has pledged to donate $25,000 annually to BFR for Lewa specifically. In addition, proceeds from a conservation coffee of the month will also be contributed. Zarraffas will also be hosting their own BFR events. They are a very conservation and community oriented company that we are pleased to partner with to save wildlife worldwide. See

http://zarraffas.com/

Growing BFR Events Over 25 Years
In 1990, we raised $138,000 from 35 chapters. Today, we have over 80 chapters participating raising over $581,000 annually. Our accomplishments are grand but we must keep pushing forward to help save wildlife for future generations. Together in conservation we can accomplish our goal and raise $600,000 annually with 100% participation from all AAZK chapters!

2014 BFR Results
In 2014, BFR raised $581,324 with 80 chapters or institutions participating. This compares to 2013 with $481,449 raised by 76 chapters or institutions and 2012 with $337,191 raised by 71 chapters.

2015 BFR Results to date
As of the writing of this paper August 12th, chapters were just beginning to turn in funds but are already up to $154,000. The **2015 winners have not been determined** since the deadline for trip winners to turn in funds is September 1st.

The 2014 Top ten Individual money raisers were:
#1- Samantha Cadman - Los Angeles with $50,000-**wins 2 week trip to Lewa**-All time record!
#2- Carolyn Leonard- Portland w/ $47,284 -**wins 2 week trip to Lewa**
#3-Teresa Randall-Oklahoma City - w/ $25,691 -**wins 2 week trip to Indonesia**
#4- Robbie Clark-San Diego- w/ $19,000 **wins 2 week trip to Indonesia**
#5- Angie Snowie-Toronto $17,422
#6-Lisa Van Slett-Dallas $14,408
#7-Emily Hallford-Tulsa $11,000
#8-Joe Hauser-Buffalo $10,164
#9-Lindsay Ireland-Detroit $9,300
#10-Gil Myers- National Capital-$6024.77

The 2014 top 3 money raising AAZK chapters were:
#1- Los Angeles-$50,010 (all time record!)
#2- Portland-$47,284
#3-Utah-$27,471

Top 10 money raising chapters since Bowling For Rhinos started in 1990 (as of 12/1/14):
1) Portland-$ 292,842
2) Oklahoma City- $288,939
3) Dallas-$222,909
4) San Diego-$217,066
5) Los Angeles- $216,708
6) Detroit-$202,622
7) Utah- $197,413
8) Lincoln Park-$153,305
9) Greater Philadelphia- $149,166
10) North Carolina- $145,979

Honorary BFR Trip Winner
Each year, AAZK and Lewa reward an outstanding individual who has gone above and beyond in their extraordinary effort to organize BFR events. Often times, these behind the scene efforts go unnoticed. It takes a great deal of effort to hold successful BFR events year after year.

The 2015 Honorary trip winner is Mollie Coym of the Houston Zoo.. Mollie and a companion will be hosted by Lewa in October 2016. Thank you Mollie for your years of dedication to making BFR successful!

Trip winners have won trips with as little as $850 (1995) to as much as $50,000 in 2014. Trip winners have been from 18 DIFFERENT zoos. If we include the honorary trip, that number would be 23 DIFFERENT zoos!

Chapter award: Jacksonville AAZK has bowled every year since 1990 and has now raised over $ 92,403.

See Appendix I (History of Funds Raised) on website: http://aazkbfr.org
See Table 1 for a comparison of events over the years.
See Table 2 for Distribution of funds

BFR Division of Funds
The first $160,000 raised each year will continue to go to LWC. Blue Rhino Gas $5,000 donation is split between Lewa and IRF. Once the $160,000 plateau has been achieved AAZK shall divide the remainder of BFR funds based upon percentage under the following distribution guidelines to the following entities until a $350,000.00 plateau is achieved:

International Rhino Foundation (IRF)	65%
Lewa Wildlife Conservancy(LWC)	25%
Action for Cheetahs Kenya (ACK)	8%
AAZK Inc Conservation Resources	2%

For BFR events that reach **$350,000-$500,000** in a calendar year, the financial distribution follows:
$160.000.00 LWC Dedicated Share
$ 50,000.00 IRF Dedicated Share
65% of Balance to IRF
25% of Balance to LWC
8% of Balance to ACK
2% of Balance to AAZK Conservation Projects

$500,000.00 and above

45%	LWC	$225,000.00
45%	IRF	$225,000.00
8%	ACK	$ 40,000.00
2%	AAZK	$ 10,000.00

As one can see, our goal is to reach the $500,000 annual level. All organizations benefit the more we can "grow" our events. We believe this is achievable but will take having everyone participate is some fashion every year. So come join us and let's grow together!

Bowling For Rhinos Tips for Success
-**Set a date early** so that it can be advertised in as many newsletters, fliers as possible. Info should be placed in **zoo newsletters** at least 4 times**, zoo volunteer newsletters**, zoo guild communications, **zoo maps or fliers**, etc.
-Check with your **Chamber of Commerce** prior to setting date to find out events that could conflict. Once you choose the date, inform your Chamber of commerce.
-Use **Social media** to advertise your event
-Talk to your **zoo volunteers at an organized luncheon** to let them know they can join the event or

sponsor someone (have your forms ready).
-Put registration fliers in an area where volunteers may see them-in their "check –in" area
-Talk to your Zoo Guild or other organization that helps at the zoo
-Have fliers that you can hand out so they can fill out later
-**collect door prizes**. Seek the big airline prizes 4-6 months in advance (write thank yous)
-Restaurants are easy to get prizes from. **Go in person with letter of donation request in hand.**
-send out **invites to previous bowlers** (addresses listed on sponsor forms from prior year or gather email addresses)
-Invite Blue Rhino Gas folks in your area to join your event (they might even sponsor)
-Invite Rhino Linings folks in your area to join your event (& possibly sponsor)
-Let people know your event is **open to the public**
-Seek **donations** for pizzas and t-shirts
-See if your zoo will offer a **Day off work** for the team who raises the most $ (ex. Graphics team, Maint. Team, etc)
-Seek help from your zoo's **special events people**, **graphics,** etc. to get the word out.
-circulate the current **list of prizes** as they come in wherever possible
-**INVITE CELEBRITIES** to bowl at your event (especially TV/radio- free advertising when they talk up event!)
-Post info next to **rhino/elephant exhibits** about your upcoming event and how to join!
-If you are going for the trip prize, **let potential sponsors know they could help you win the trip!**
-Send out letters/emails to friends and family seeking donations.
-Check out **http://aazkbfr.org or http://aazk.org/committee/bowling-for-rhinos/**
Lewa Promo CDs & materials, "Patrols of Hope-The last Sumatran Rhino" CD, how to hold a successful event info and more can be found here. For additional Lewa promo materials, contact: Ginger Thompson at ginger@lewa.org and for additional IRF promo materials, contact: Susie Ellis at: s.ellis@rhinos.org
- contact Patty Pearthree at: ppear3@gmail.com or 919-678-0449

BFR Fund-raising Guidelines
• If possible, Events should be held between March 1- August 1st (optimal for PR is 1st week of May).
• If interested in participating, see http://aazk.org for information and go to the members only section to download sponsor forms + send your event coordinator contact info, date of event,etc,: ppear3@gmail.com
*If you have never held an event, see "how to hold an event" on the web site: http://aazkbfr.org.
• There is a **$25 administrative fee** to participate, which should be made out to "AAZK, Inc." and mailed to Patty prior to your event. This fee covers indirect costs incurred by AAZK, Inc. due to BFR (phone, postage, faxes, and bank and online donation fees). Administrative fees are waived for the first year a chapter participates.
• **To win the trips, all money must be sent in to the AAZK office by September 1st!**
• **Please try to have all money sent within 30 days of your event.**
• If a chapter does not wish to send their checks certified mail, the following is the only way to insure that your check is not cashed by anyone other than AAZK, Inc.! **Please write "For Deposit Only" on the back signature area of all checks. This will ensure only AAZK can deposit it instead of just anyone who may intercept it!**
• Please make out one check payable **to "AAZK/BFR",** include a copy of your financial form & a copy of sponsor sheets from **all members raising at least $1,000** and mail to:

AAZK Office
8476 E. Speedway Blvd. Suite #204 Tucson, AZ 85710
(919) 678-0449 ppear3@gmail.com

*It is very important to remember that we advertise **100% of all donations go towards conservation**. All

donations from donors must be submitted to AAZK Bowling For Rhinos for this to be true. This means that your organization must cover any expenses for this event. This can be done by charging a fee for bowlers, through silent auctions, door prize raffles, your local organizations funds, etc.

*Anyone can join the Bowl-a-thon so **don't limit yourselves to only zoo people. However, be sure it is clear that only National AAZK members are allowed to win the trips.** If you have a potential winner, ask them to join AAZK.

* **Blue Rhino Gas Company**

The Blue Rhino Gas Company became the **National sponsor of Bowling For Rhinos** beginning in 2004. The Blue Rhino gas company is extremely conservation oriented and uses the white rhino as their logo. They pledged to donate $20,000 per year to Bowling for Rhinos through 2008. Beginning in 2009, this was scaled back to $5,000 due to the rough economic times for gas companies. Blue Rhino is the leading cylinder gas recycler in the U.S. and keeps thousands of cylinders out of landfills each year. Some chapters have also received additional support from their local Blue Rhino Gas suppliers. See www.bluerhino.com for more information.

*Don't forget to use **Blue Rhino Gas** for any grilling needs- they help save rhinos too! Any publicity for them will help increase their future support of BFR.

Table 1 AAZK BFR Comparison of Funds Raised Year to Year

Year	Total Raised	# Events	Top Money Raisers	Amount	Chapter Affiliation	Top Chapter	Amount
1990	$138,795	35				Portland, OR	$14,659
1991	$122,801	40	Patty Pearthree Brian McKenna	$4,877 $3,791	Indianapolis Lincoln Park	Lincoln Park	$12,697
1992	$99,393	47	Cara Lance Debbie Palay	$4,977 $1,743	Indianapolis Lincoln Park	Lincoln Park	$11,102
1993	$112,015	44	Richard Buthe Kathy Knowin	$5,070 $4,960	Philadelphia Lincoln Park	Philadelphia	$13,168
1994	$106,452	53	Diana Villafuerta Christine Bobko	$3,505 $3,146	Lincoln Park Denver	Portland, OR	$10,821
1995	$120,657	45	Patty Pearthree * Katrina Osborn	$1,767 $1,488	Indianapolis Miami Metro	Portland, OR	$11,398
1996	$149,249	49	Bill Nelson Jay Weston	$5,670 $3,498	Dallas Hogle	Dallas	$14,757
1997	$128,604	43	Janet Wiard Mary Wykstra-Ross	$6,256 $5,240	Oklahoma City Hogle	Dallas	$10,865
1998	$124,920	43	Norah Farnham Kirk Nemecheck	$7,539 $5,406	Lincoln Park Rolling Hills	Lincoln Park	$12,653
1999	$135,625	38	Brenda Gunder Dolora Batchelor	$10,618 $6,245	Rolling Hills Miami Metro	Portland, OR	$13,311
2000	$143,083	37	Kirsten Christensen Tim Hays	$12,201 $6,816	Oklahoma City Rolling Hills	Oklahoma City	$12,201
2001	$192,789	42	Jay Pratte Debie Mangrum	$10,161 $9,467	Dallas Oklahoma City	Dallas	$17,877
2002	$158,456	40	Victoria Zahn	$16,607	Oklahoma City	Oklahoma City	$16,607

			Bethany Lutz	$9,200	Hogle/Utah		
2003	$188,643	44	Mary McFarland Jason Peterson	$13,593 $11,500	Oklahoma City Hogle	Puget Sound	$16,462
2004	$214,271	42	Todd Bridgewater Michelle Pratt Bethany Lutz Mike Connolly	$17,680 $13,435 $12,000 $6,000	Oklahoma City Detroit Hogle Tulsa	Detroit	$19,494
2005	$233,950	47	Chrislyn Newton Crystal Derusha Jessica Scallan Alex Vasquez	$18,074 $14,000 $9,000 $8,706	Oklahoma City Utah Tulsa Dallas	Oklahoma City	$18,704
2006	$250,577	53	Amy Stepens Kelly Wilson Jane Larson Eric Flossic	$21,025 $18,478 $14,200 $13,000	Oklahoma City Detroit Utah Tulsa	Oklahoma City	$21,025
2007	$316,397	53	Jaimee Flinchbaugh Ruth Ann Prey Rana Bayrakci Heather Strawn	$31,091 $28,359 $14,088 $12,498	Oklahoma City Detroit Puget Sound Cleveland	Oklahoma City	$31,091
2008	$273,279	55	Jennifer Davis Christine James Jennifer Thomas Rue Hewett Kim Sevier	$35,388 $14,554 $12,150 $11,000 $11,000	Oklahoma City Dallas Detroit Miami Metro Tulsa	Oklahoma City	$35,388
2009	$256,785	53	Nicole Miller Gina Garza	$30,101 $13,327	Los Angeles Dallas	Los Angeles	$30,101
2010	$256,420	61	Dani Cremona Melissa Kesler	$30,000 $15,000	Los Angeles Oklahoma City	Los Angeles	$30,000
2011	$280,015	65	Cori Monetti Holly Ray	$32,000 $14,232	Los Angeles Oklahoma City	Los Angeles	$32,000
2012	$337,191	76	Jennifer Gonsman Ashley Orr Gil Myers Logan Agan	$35,500 $13,901 $10,817 $9,589	Los Angeles Dallas National Capital Oklahoma City	Los Angeles	$35,500
2013	$481,449	76	Mike Bona Ann Knutson Kenton Kerns Crystal Butler	$35,800 $24,340 $15,716 $15,701	Los Angeles San Diego National Capital Oklahoma City	Los Angeles	$35,800
2014	**$581,325**	**80**	**Samantha**	**$50,000**	**Los Angeles**	**Los**	**$50,010**

			Cadman			**Angeles**	
			Carolyn Leonard	$47,284	Portland		
			Teresa Randall	$25,691	Oklahoma City		
			Robbie Clark	$19,000	San Diego		

**** indicates record amount raised**

*Third place won trip this year as each winner can only win once.

Table 2: Bowling For Rhinos Distribution of Funds

Year	LWC	Indonesian Programs		ACK	AAZK Conserva-tion
		Through Adopt-A-Park	Through IRF		
1990	$138,795				
1991	$122,801				
1992	$99,393				
1993	$112,015				
1994	$106,452				
1995	$100,000				
1996	$100,000	$20,600			
1997	$100,000	$49,250			
1998	$100,000	$14,302	$14,302		
1999	$100,000	$12,460	$12,460		
2000	$100,000	$17,813	$17,813		
2001	$105,000	$21,541	$21,541		
2002	$100,000	$43,895	$43,895		
2003	$100,000	$29,228	$29,228		
2004	$110,000	$44,321	$54,321		
2005	$130,000	$47,453	$57,453		
2006	$130,000	$47,055	$57,055		
2007	$160,000	$55,387	$65,387		
2008	$160,000	$0	$156,397		
2009	$196,714	$0	$50,893	$7,343	$1,836
2010	$185,355	$0	$61,923	$7,314	$1,828
2011	$191,254	$0	$77,260	$9,201	$2,300
2012	$206,208	$0	$115,850	$13,705	$3,426
2013	$249,781	$0	$207,745	$19,138	$4,784
2014	$275,151	$0	$248,138	$44,364	$10,880
2015		$0			
Total	**$3,478,919**	**$403,305**	**$1,291,661**	**$101,065**	**$25,054**

PROGRAMMATIC AND FINANCIAL REPORT
LEWA WILDLIFE CONSERVANCY RHINO CONSERVATION PROGRAM
July 2014 - June 2015

The Lewa Wildlife Conservancy remains extremely grateful for the continued support from the American Association of Zoo Keepers (AAZK) through the very successful Bowling for Rhino (BFR) program. AAZK contributed a total of $**266,951,** inclusive of support received from Zaraffas Coffee Franchise, Australia--towards Lewa's rhino protection and security operations between July 2014 and June 2015. By supporting Lewa, home to 12% and 14% of Kenya's black and white rhino respectively, AAZK is directly linked and involved in *insitu conservation* efforts ensuring the survival of these endangered species.

This report outlines how AAZK's generous funds were utilized over the reporting period. This funding enabled support towards rhino conservation and security operationsincluding the armed anti-poaching units, tracker dog unit, aerial surveillance, ranger salaries, vehicle running costs and radio communication center.

Rhino Conservation Programme

Lewa was lucky to not lose any rhino to poaching in 2014, in the wake of having lost seven the previous year. An immense amount of dedication and great effort went into deterringcontinuous attempts on Lewa's rhino. The poaching threat continues to escalate to heights never seen before mainly because of an increase in the demand for rhino horn and elephant Ivory.This dramatic increase is the result of a variety of factors, most notably the growing purchasing power of both Middle Eastern and Asian populations, and the sophistication of organized poaching gangs who sell these wildlife products to black market syndicates in range countries.

There are great steps being taken in an effort to curb poaching in the country --by the government and other stakeholders-- resulting in a notable decrease in rhino poaching across different parts of the country with minimal incident reports. Lewa's impressive anti-poaching team's track record is well known throughout the conservation world, and can be attributed to the attention, detail and constant adaptation of activities to meet the ever growing and changing threats from poachers. Lewa strives to address allconceivable angles of threat to its' rhino population through daily monitoring of each rhino, vigilant observation of all entry points and conservancy boundaries, constant maintenance of the fence line, regular aerial surveillance, intelligence gathering and the related community development supportrequired and the continuous training of its entire security force and canine unit in preparedness for any eventuality, that could threaten the Conservancy's resident wildlife.

The Lewa rhino population has stabilized after a successful translocation of 9 black rhinos to the Sera Conservancy, the first community conservancy in East Africa to receive black rhino, early this year with the approval and assistance of Kenya Wildlife Service. This has somewhat helped the Conservancy to maintain its' ecological carrying capacity at a manageable level allowing rhino to breed and roam freely with less conflict over territory, a condition that is critical to the effective management of this species.

National Police Reservists (NPR) Armed Anti-Poaching Teams

37 members of Lewa's 150-person security team are categorized as National Police Reservists (NPR), trained and employed by Lewa, but also approved by the Kenyan government to carry firearms and respond to incidences of instability or violence throughout the region. Lewa currently has its teams deployed on a daily basis to different locations to ensure greater coverage of the Conservancy.And surrounding communities. The anti-poaching units are positioned throughout the Conservancy at all times and particularly at night, with one team based at headquarters as a rapid response unit, ready to deploy at any given moment and around the clock.

Aside from their constant monitoring and regular responses to incidences on and off the Conservancy, Lewa's KPR teams are always augmenting and improving upon their operations and training. A training regime that encompasses new skills development and skill training refreshers has been put in place where each member of the NPR teams and no includes basic medical trainingwithone person on each team attending an advanced field-medical course in order to be prepared to deal with any case of

serious injuries. The teams carry medical kits with bandages, tunicates and other necessary supplies. Their uniforms were also upgraded to include insulating base-layers and gloves to protect against high-elevation bitter cold nighttime temperatures that they sometimes experience. The team is also well equipped with modern equipment including but not limited to night vision goggles and thermal imaging equipment, which enhances the team's ability to work at night in response to any poaching and other security threats. Lewa's NPR team has continued to enhance its collaboration with the government system especially the county government of the counties of Isiolo, Meru and other neighbouring counties in addressing security matters.

The total cost to effectively run the NPR armed team including salaries, rations, medical, uniforms and allowances was **USD$207,056 .**The table below indicates all operations and responses to incidences between July 2014- June 2015.

Incident	Total reported during the Period
Armed NPR deployments / follow-ups to serious security incidents	28
Tracker dog deployments	18
Aerial follow-ups and reconnaissance	15
Rhino Poaching incidents reported within Lewa	0
Road banditry reports	30
Stock theft reports	44
Elephant carcasses / tusk recovery	26
Robbery reports	6
Arrests	19
Firearms / weapons recovered	6

Tracker Dog Unit

Over the years, Lewa has developed a good reputation for its canine unit. The Kenyan Government calls upon this impressive team regularly to assist in a wide range of situations that require quick responses and scent tracking. Currently there are 2 male blood-hounds, Tony and Tipa and five dog handlers all of whom are well trained and continue to follow a daily training regimen to keep them fit, alert and motivated.

Over the grant period, the tracker dog team has been used in a total of 18 security follow-ups and has provided invaluable assistance to these situations.

The total cost to operate the canines and their handlers over this reporting period was **USD$20,238**

Aerial Surveillance & Support

Lewa's aerial surveillance continues to play a key role in all operations, supporting not just Lewa's security operations, but also partner organizations. The LWC Super Cub acts as back up to security related follow-ups to Lewa and other conservation partners nearby such as Ol Pejeta, Ol Jogi and other Northern Rangeland Trust member conservancies.

The super-cub has been particularly useful in responding to the upsurge in poaching threats, local stock-theft incidences and road banditry. The aircraft is also an invaluable resource in locating missing rhino and in completing the annual wildlife count.

The ability to carry out aerial surveillance is one of Lewa's most important tools in protecting the rhino populations and combating insecurity. Without this tool, it would be impossible to provide the current high-level of wildlife protection and security response that Lewa is relied upon for.

Lewa also acquired a MD 350 Helicopter, which has greatly enhanced response to the overwhelming poaching threat within the region;this aircraft eases capture activities and ensuresaccurate game counts. This Helicopter has and will greatly continue to support anti-poaching activities.

Over the reporting period, the total cost of operating the LWC Super Cub aircraft and MD 30 Helicopter in support of the security deployment and surveillance was **USD$ 39,880 (** cost calculated on an hourly basis**).**

Field Monitors Salaries

Lewa's rhino monitoring team is made up of **27** field monitors who daily monitor specific regions or "blocks" of the Conservancy. In response to the escalating poaching threats the Conservancy has restructured its 18 blocks to 9 so that the team can have a bigger presence and conduct round the clock security and surveillance of Lewa's rhino populations and other wildlife. The field monitors radio back to Lewa's operations room to report on the location of each rhino, as well as any unusual signs of human behavior or entry into the Conservancy. The monitoring system has been adjusted to maximize efficiency and increase the daily protection of each animal, by the use of an advanced digital communication system.The team also facilitates the collection of any information that helps in preventing any poaching activities through collaboration with the neighboring community. Finally the team has now been called upon to report on all wildlife activity to help Lewa better understand and manage migrations, territorial turf competitions, browse and grassland conditions and other relevant elements of the environment.

Lewa's rangers are highly trained and equipped to track the rhino's day and night. Using binoculars, they can identify each of the animals in their block based on age, ear-notching pattern, sex and `behavior. Lewa's wildlife and security teams aim to locate every individual rhino each day with the main objective of reporting 100% rhino sightings to the operations room at Lewa Headquarters. Any lengthy disappearances of any individual rhino, acts as a sign of either illness, injury, calving and or poaching; all field staff treat these situations as high-alert incidents and double up to make sure each rhino is spotted. In most instances rhino's change territory due to emergence of younger males who chase away the older ones,mostly attributed to the scarcity of grass land (whites) and forage (blacks) due to increased number of rhino and prolonged dry periods with no rainfall on Lewa and in northern Kenya more generally. The drought conditions push ranging wildlife (Elephant, Giraffe, Eland, Oryx) into Lewa and result in additional pressure on vegetation.

The other very important teams include the orphaned animals handlers who take care of Lewa's 3baby rhinos to ensure they are protected from any attack from other wildlife like the lions, leopard and elder rhinos. These keepers are with the young rhinos day and night.

The total cost to operate 27 rhino surveillance rangers patrolling the "blocks", 21 gate guards, 11 night watchmen, 2 armory guards, 5 dog handlers, 6 radio operators, 2 wildlife capture men, and 3 orphaned animal handlers for this reporting period is **USD$ 268,235**

Security Vehicles

The LWC security team has three vehicles, one for regular rhino monitoring and twofor the armed NPR units. As a result of the increased poaching threat and the rough terrains within the conservancy and the neighboring community, the security vehicles are driven round the clock, to monitor every member of LWC's rhino population and other wildlife as well as in response to reported situations of instability in the community settlement areas. This level of mileage and overall wear and tear from constant usage on difficult terrain has taken a toll on these vehicles. While the Lewa workshop has done an excellent job of keeping these vehicles running safely and consistently, the old vehicle for regular rhino monitoring will eventually need to be replaced. This has contributed to a higher cost of maintaining and running the vehicles within this reporting period.

AAZK's funding was used to support part of the running costs of all three vehicles,total cost support from AAZK coming to **USD$ 34,366.**

Radio Operation Room Communication Costs

Lewa's radio room is the linchpin of the Conservancy's security operations, providing a central point of communications for the entire region. Lewa's impressive communications unit manages all aircraft coming in and out of Lewa, as well as maintaining records of each rhino's specific movements through tracking with the help of the field monitors located in different areas within the Conservancy, sighting and reporting the rhinos' movements. Most importantly, the communications team plays a vital role in the community, where anyone can call in with tips of potential poaching plans or other security threats.

Through its radio communication LWC has been able to relay messages accurately and coordinate effective interventions for many security occurrences. This is enhanced through collaboration and linkage with relevant security agencies like the KWS, Kenya Police and other government agencies. It is adequately equipped with modern communication devices and manned by highly trained personnel.
AAZK funding contributes to the costs of radio repairs, purchase of spare batteries, staff salaries and radio licensing. Over this period the radio communications operation and intelligence network operations on LWC cost **USD $27,265.**

(Lewa Communication Centre)

Total Expenditure towards Rhino Conservation Programmes

AAZK contributed significantly by donating **US$266,951**towards the Conservancy's overall expenditures to protect rhino. These costs reflect the core function of Lewa'sday-to-day work, specifically focusing on rhino conservation. AAZK's long term and continuous funding makes it a vital contributor to the success of Lewa, in its conservation initiatives. We are indebted for the support AAZK has been contributing to Lewa over the years.

We are very pleased to be able to continue hosting the BFR annual winner's trip and also the honorary BFR winner's trip to LWC. It is great to see the continued commitment of BFR members and we look forward to working with you long into the future.

We at Lewa Wildlife Conservancy are grateful tothe AmericanAssociation of Zoo Keepers and Bowling For Rhino for their continued support spanning the last two decades.

Financial Report for Period, July 2014 to June 2015.
Lewa Wildlife Conservancy

Submitted to American Association of Zoo Keepers Bowling for Rhinos Program

INCOME RECEIVED BY LEWA, KENYA	AMOUNT
Funds received from AAZK BFR on 12th September 2014	**-$100,000**
Funds received from AAZK BFR on 6thJanuary 2015	**-$141,951**
Zarrafas	$ 25,000
TOTALS	**$266,951**
Expenditure	**Amount**
AAZK contribution to salaries for KPR Anti-Poaching Team	**$55,665.00**
AAZK contribution to Dog Section operational expenses	**$ 7,969.00**
AAZK contribution to operating expenses for aerial Back-Up	**$16,576.00**
AAZK contribution to LWC Rangers salaries	**$116,801.00**
AAZK contribution to Motor Vehicle running expenses	**$ 12,592.00**
AAZK contribution to radio communication expenses	**$ 10,322.00**
AAZK contribution to boundary fence maintenance	**$17,991.00**
AAZK contribution to Lewa oversight, administration, travel	$29,034
TOTAL	**$266,951**
Balance	**NIL**

Note: AAZK contributed 42.7% of the total Rhino protection expenses incurred during the period

The total Expenditure incurred by LWC on Rhino protection during the period is as follows:

Description of cost line	Amount (US$)
KPR Anti-Poaching Team	**207,056**
Dog Section	**20,238**
Aerial Back-Up-Super Cab and Helicopter	**39,880**
Ranger Salary	**268, 235**
Motor Vehicle Running Cost	**34,366**
Radio Communication	**27,265**
Boundary fence	**28,648**
TOTAL EXPENDITURE	**$625,688**

Susie Ellis, Ph.D.
International Rhino Foundation
Executive Director
s.ellis@rhinos.org; tel 540-465-9595

Paper Title:
Indonesian Rhinos: How Bowling for Rhinos is Conserving the Most Critically Endangered Mammals on Earth

The two Indonesian rhino species, which AAZK's Bowling for Rhinos program has helped to conserve since 1996, may well be the world's most critically endangered mammals. Shy, secretive rainforest dwellers, Javan rhinos now number about 60 animals in one site, and Sumatran rhinos number no more than 100 in three sites in Indonesia. Sumatran rhinos have had a precipitous decline of more than 70% population loss over the last 20 years – but not in the areas in which AAZK supports their conservation. This past year, rhino experts developed new recovery plans for both species, which include a number of bold actions designed to reverse their decline and maximize the potential for population growth. This paper provides an update on these plans. AAZK support for the Indonesian Rhino Protection Units, the backbone of the species' protection, has never been more important. Bowling for Rhinos support ensures that AAZK plays a critical role in their long-term survival and recovery.

AV requirements: LCD projector, computer that can play video with sound

Action for Cheetahs in Kenya: Framework for a National Cheetah Survey

Mary Wykstra
Action for Cheetahs Director / Principle Investigator

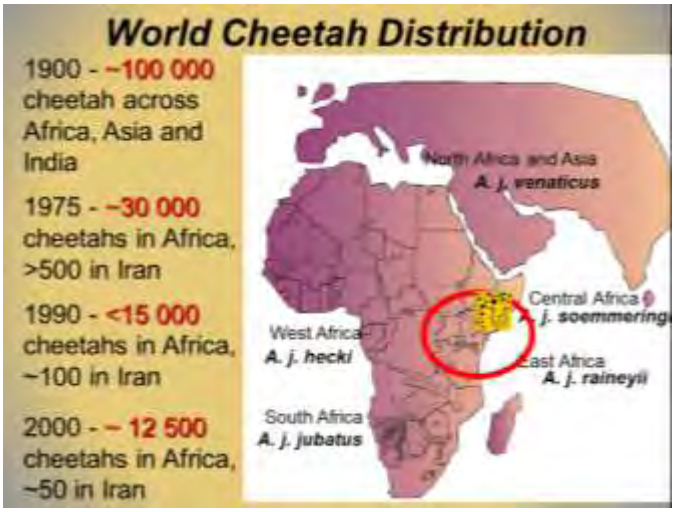
Address: PO 1611 Nairobi Kenya 00606
Phone: +254733997910
Email: info@actionforcheetahs.org

Abstract:

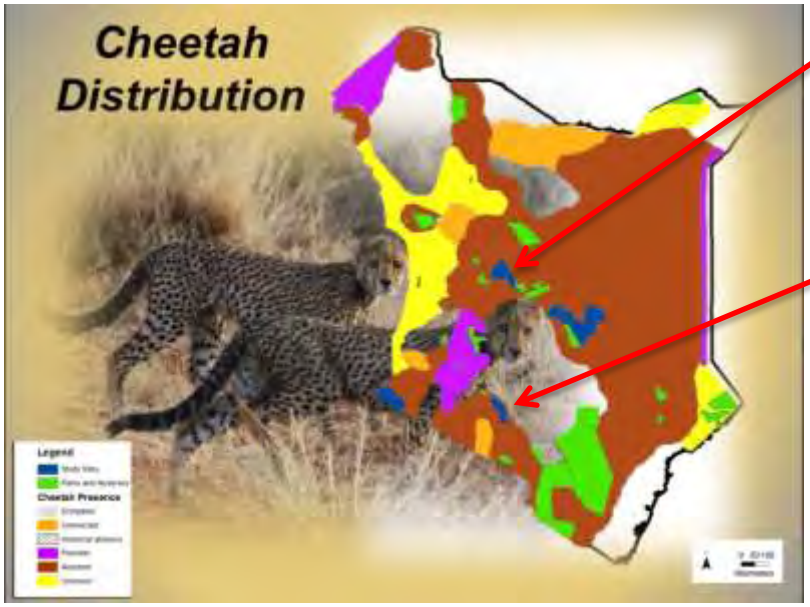
Action for Cheetahs in Kenya (ACK) is works in the Meibae Conservancy to understand cheetah behavior, prey selection and movements in the Samburu Region. The area supports an average of 23 adult cheetahs as well as silver-backed jackal, spotted and striped hyena, caracal, leopard and wild dogs. Since 2009, Bowling for Rhinos supports the work of ACK in this region. Cheetah Field Officers work with students and volunteers to conduct pilot studies that form the base for cheetah monitoring on a range wide scale. Field work includes wildlife monitoring in collaboration with the Kenya Wildlife Service, Meibae Conservancy and the Northern Rangelands Trust. Bowling for Rhinos funds support over 70% of the work in this region, and with the success of the 2014 BFR also supports 5% of the operating cost for the national survey pilot work.

ACK Mission: *Promote the conservation of cheetahs through research, awareness and community participation in Kenya*

Throughout the cheetah's home range it is vulnerable to the threats that lead to wildlife population decline. While Namibia has the strongest population estimated at around 3000 – Kenya is the central population to the whole of eastern Africa. We estimate the Kenya population to be 1200-1400 based on studies completed in 2007. The trans-boundary issues with neighboring Tanzania, Uganda, Ethiopia, South Sudan and Somalia create a contiguous population facing similar threats.



The cheetah is a charismatic species, often used as an icon for speed and elegance. But the future of the cheetah is threatened by land fragmentation, loss of critical habitat and conflict with people. As with most predators, the conflict over resources and space results in decline of the species. Field data has been collected in the Samburu District since 2010. Research is goal oriented through understanding the problems encountered by people living with wildlife; developing research methods and sharing our findings with local communities, Kenya Wildlife Service, agriculture and livestock partners, and other experts. The primary focus of academic research is in gaining understanding of cheetah health and adaptations to the changing land use. The community focus is to mitigate conflict and raise awareness of non-lethal predator control options.



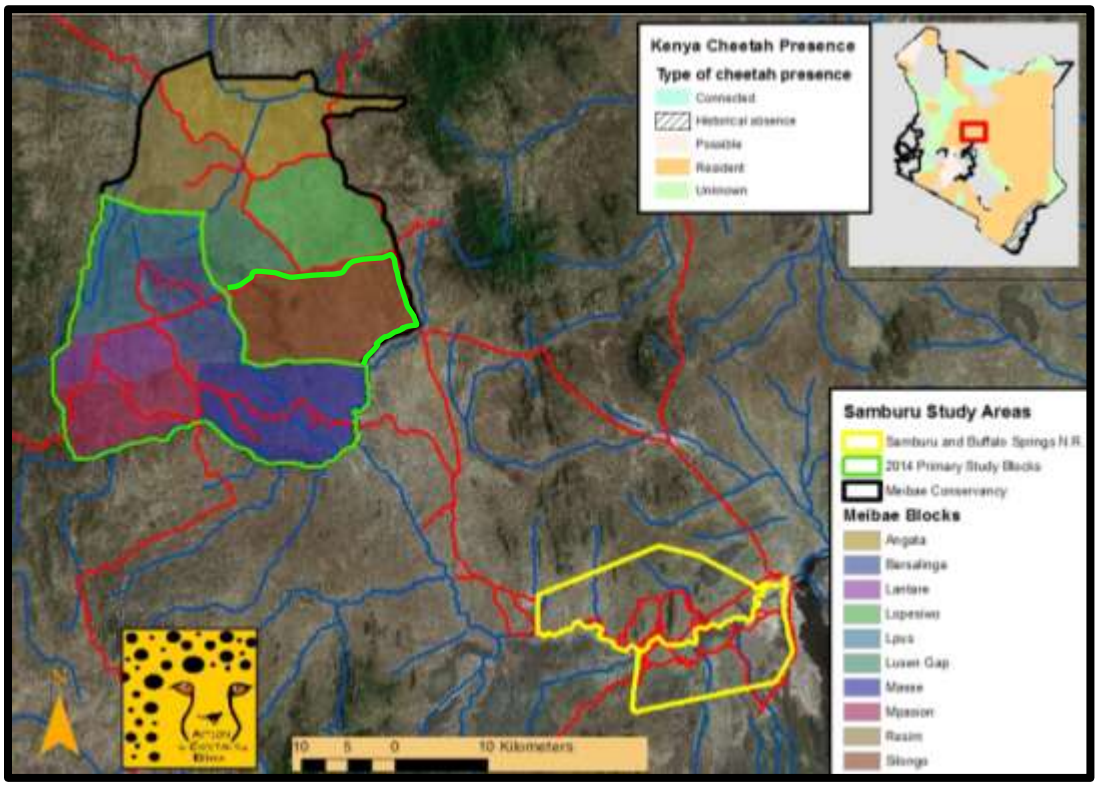
The Meibae Conservancy and Samburu National Reserve are located in northern Kenya. In 2015, ACK opened our second field base at the conservancy HQ. Our first field base in the Salama area of the Makueni District was the first field site. In 2012 we extended our research in this region into theAthi-Kapiti region of the Machakos and Kajiado Districts. Research in these areas provide pilot studies that enable us to develop methods for range wide conservation actions.

Photos: Above - two primary ACK field sites. Right - ACK field staff

We added two new field officers to reduce the area covered by our senior officer so he can increase his role in supervisory and data entry aspects. Chris Lentaam has now received his driving license and computer training in increase his capacity for leadership in conservation. We are hoping to support Chris in university in 2016.

While the cheetah rarely attacks a boma at night, many of the conflicts in both day and night are blamed on the cheetah. Pilot studies in 2014 provided the baseline for masters student, Adriana Casillas from Antioch University New England. She used foot patrols and camera traps to monitor predator activities at bomas set up with two different types of lights. Lion and Elephant Deterrent Systems (LEDS) remain the most effective short term solution. Fox Light deterrents reduced visitation by 75%.

Photos: Types of lights and camera set up in testing fox lights, LEDS, NiteGuard and Predator Guard systems with combinations of noise producing reflective tape.



In the Samburu National Reserve we continue to use rangers and naturalists to collect cheetah data. The cheetah we collared in 2010 returned to SNR with two new cubs. Natanywe and her cubs are among 17 cheetahs frequently sighted in the reserves.



***Photos**: Natanywe was radio collared in 2010. The collar was removed in 2012 when her cubs were about one year of age. In2014, she raised two new cubs to adulthood. Mom and growing cubs were seen repeatedly into 2015.*

Education and information sharing is the backbone of our work within the community. While school presentations and activities promote conservation ethics in our future leaders we also engage the out-of-school youth and the adults through community meetings, stakeholder workshops, sporting events and community development projects. 20% of BFR funds are spent on meetings, presentation materials and community events.

FINANCIAL REPORT

The primary source of income for ACK activities in the Samburu study site is from Bowling for Rhinos. Funding through zoo grants and AAZK chapters support the long-term conservation efforts and other regions of ACK focus. Students and volunteers are self-funded or utilize funds through joint grants with ACK. Below is the income and expense for 2014 - 2015 for the Samburu project. The full operational budget for ACK in 2014 was $85,000. The Samburu portion of the work in 2013 accounted for 20% of the total ACK budget.

INCOME 2014-2015

Received BFR 2014:	$19,138.00
Received BFR 2015:	$44,363.00
Total Available:	$63,501.00

Expenses 2014 (January – December)

Meibae Conservancy Fee	$ 250.00
Field Officer Stipend and training	$4304.00
Transport (Fuel, Insurance, Public service)	$3880.00
Accommodation (Camping fees, lodging, food)	$ 833.00
Office Equipment and Supplies	$3592.00
Motorcycle Purchase, Insurance	$ 583.00
Community Programmes	$ 1783.00
Expenses 2014	**$15,255.00**

Expenses 2015 (January – June)

Meibae Conservancy Fee	$ 250.00
Field Officer Stipend and training	$3176.00
Transport (Fuel, Insurance, Public service)	$ 696.00

Accommodation (Camping fees, lodging, food)	$3850.00
Camp Construction	$10104.00
Office Equipment and Supplies	$ 112.00
Motorcycle Fuel	$ 182.00
Community Programmes	$2096.00

Expenses to Date 2015 $20,466.00

Balance remaining for 2015: $27,780.00

PROJECT GOALS AND ACTIVITIES 2015-16

The following goals will be achieved for two study areas by ACK staff.

Goal 1: Identify factors affecting cheetah livestock predation and mitigate conflict.

a. Prey Distribution and Abundance: Data from the Samburu area will be analysed for annual reporting and used as the baseline for continuing studies

b. Human Settlement Pattern: Complete publications using data from 2005-2013 and start pilot occupancy project for National Survey.

c. *Evaluate Livestock Depredation:* Conflict mitigation efforts include herder training, boma reinforcement, predator deterrent lights and livestock health improvements.

Goal 2) To understand cheetah health and habitat selection

a. *Monitor cheetah presence and movements through observation:* Monitoring methods include direct observations, camera trapping, spoor counting and verification of public sighting reports. Cheetah Scouts collect cheetah-sighting reports and verify predator spoor. Data is entered into an Excel database and mapped using ArcGIS for analysis and comparison annual and seasonal cheetah movements. Camera trap transects verify cheetah corridor use and provide positive ID for individual cheetahs in both the Salama and Samburu study areas.

b. *Determine habitat use of cheetahs in relation to vegetation and prey*: Boma monitoring, Vegetation surveys and highway monitoring will be included in regular cheetah field officer patrols

Goal 3: Influence public and administrative changes to positively affect cheetah conservation and management protocols.

a. Conduct community programs to disseminate findings, promote conservation awareness, and improve livestock management techniques (public meetings called baraza): Use natural resource planning to establish strategies for resource conservation and improved livelihoods.

b. *Raise environmental awareness through partnerships and internal education programmes for communities and schools*: Show wildlife videos at schools.

c. *Establish cheetah conservation protocol and the policy in collaboration with KWS and local stakeholders*: KWS and local administrative offices hold the power of prescription that guide procedures within the human-wildlife interface, thus the knowledge they receive assist in their decisions and actions. ACK provides quarterly updates to KWS and we present our research findings at an annual Carnivore Action Forum meeting. We submit updates to the National and Regional Wild Dog and Cheetah Strategic Plans to assist in the framework of cheetah conservation. Printed materials and digital submissions through our web site create awareness of activities and findings.

Changing It Up: Challenges of Rotational Exhibitry in the Asian Forest Sanctuary

By

Alicia Pike, Staff Biologist (Zoo Keeper)

Point Defiance Zoo & Aquarium

Tacoma, Washington

Abstract

A 5-acre rotational exhibit complex called the Asian Forest Sanctuary opened in July of 2004 at Point Defiance Zoo & Aquarium in Tacoma, WA. A relatively new working concept of exhibitry at the time, this new area included 5 different habitats and a "dayroom". Each animal is generally housed behind-the-scenes with indoor and outdoor access overnight. A labyrinth chute system leads to each exhibit and utilizes over 80 different doors and locks. The chute system also serves as additional animal holding space and exercise areas. Today, the Asian Forest Sanctuary features Asian small-clawed otters (*Anoyx cinerea*), Indian crested porcupines (*Hystrix indica*), Lowland anoa (*Bubalus depressicornis*), Northern white-cheeked gibbons (*Nomascus leucogenys*), siamangs (*Symphalangus syndactylus*), a Malayan tiger (*Panthera tigris jacksoni*), Sumatran tigers (*Panthera tigris sumatrae*) and a wrinkled hornbill (*Aceros corrugatus*). Over time, a revolving mixed species approach within the rotational exhibitry also became a realized concept. For example, the siamangs can be exhibited with the porcupines, or the otters with the female anoa. This area of the zoo also focuses on breeding Sumatran tigers and anoa, and has previously bred small-clawed otters. This presentation will showcase the challenges keepers face housing these species and each individual in this aspect of exhibitry; how each animal is shifted between their off-display holding area and the various exhibits, the safety precautions keepers use, and the benefits that the animals, staff, and visitors obtain in the process.

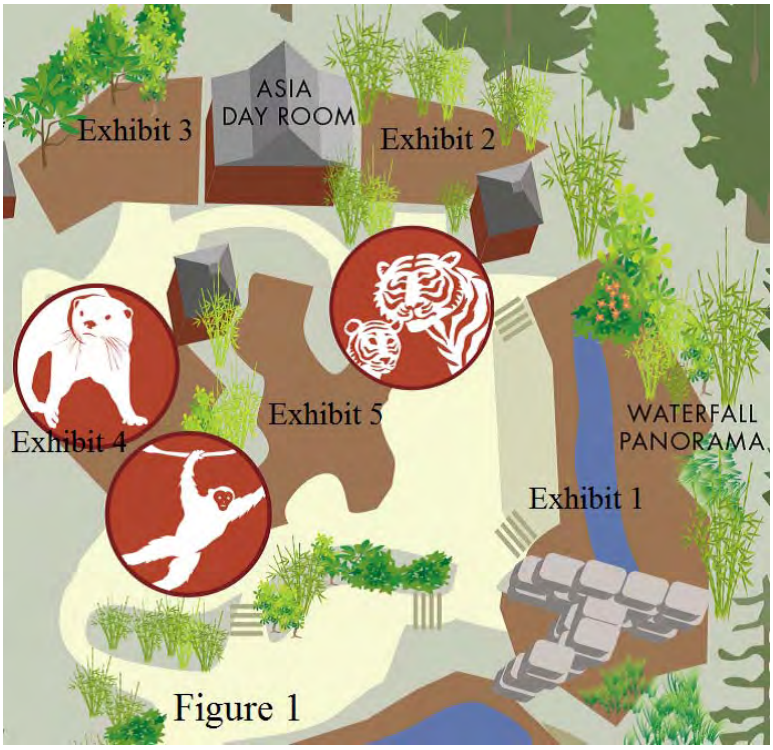
Introduction

Traditionally, zoo animals are housed only in the specific exhibits that they are displayed in or have a behind-the-scenes holding area directly connected to their exhibit. Such exhibits are usually designed for one species or taxon. Multi-species exhibits usually house the same individuals all or most of the time. Rotational exhibits may house various species at different times and need to be designed to meet the needs of all species that will reside in them at any time. At Point Defiance Zoo & Aquarium, the rotational exhibit of the Asian Forest Sanctuary house large and small carnivores, lesser apes, medium-sized ungulates, porcupines, and a bird. Most of these species can be exhibited together making for different mixed-species exhibit possibilities. The 5 different habitats (and additional indoor "dayroom") must be prepared for each species or combination of species before the animals enter them. The animals arrive at the habitats through a labyrinth of chutes with many different doors that the keepers set for them before they move through them. The challenges that staff face include managing, inter-species and intra-species interactions, habitat compatibility for each species, and shifting safely in a complicated working environment. However, the benefits gained from this rotational exhibit includes "built-in" enrichment for the individual animals, an educational experience for the guests who visit the Asian Forest Sanctuary, and adds an element of satisfaction and variety for keeper staff who consistently overcome challenges.

Asian Forest Sanctuary Exhibits and Dynamics

The five different habitats in the Asian Forest Sanctuary include a large exhibit with a sizeable pool and waterfall, three meshed exhibits, a smaller forest floor exhibit, and an indoor "dayroom". Exhibit 1 is the largest exhibit with a 200,000+ gallon pool and waterfall. Exhibit 2 is a large meshed exhibit with faux bamboo and a pool. Exhibit 3 is a large meshed exhibit with a stream and pool. Exhibit 4 is a large meshed exhibit with a steep hill and also includes a stream and two-tiered pool. Exhibit 5 is a smaller open topped exhibit with a pool and separate waterfall. The "dayroom" can be made into a 6^{th} exhibit or attached to one or both exhibits on either side (Exhibit 2 and Exhibit 3). Figure 1 shows the location of the exhibits in relation to each other. The option exists to connect all the exhibits with the chutes in between them to create a very large circle. Every exhibit can lead to any behind-the-scenes holding area, and most exhibits have more than one path for the animals to use when entering and exiting.

Figure 1: This image was modified from a current map from www.pdza.org. (The animal images do not necessarily correspond with the exhibits.)



There are four full-time zoo keepers that work in the area along with five part-time zoo keepers, two volunteers, and up to two interns at any given time. Only the full-time zoo keepers have the key that can unlock doors of exhibits, holding areas, and chute doors. On most days, there will be two to three full-time zoo keepers, two to three part-time keepers, and an intern or volunteer. In the summer, staff work 10 hour shifts and there often will be one full-time keeper and one or two part-time keepers working in the area.

From the time the zoo is open until it is closed, one pair of primates and one tiger must be out in an exhibit. All exhibits must have an animal in them soon after the zoo opens, unless exhibit repairs are being made that inhibit an animal from residing in the exhibit for the day. The first shift to bring animals off exhibit may be initiated 15 minutes before the zoo closes. Staff hours are spaced to allow for about 1.5 – 2 hours to have animals out in exhibits in the morning, and 0.75 - 1.25 hours to shift animals to their holding areas, feed them, and close the area.

Current Species in the Asian Forest Sanctuary

Asian Small-clawed Otters (*Anoyx cinerea*)

Point Defiance Zoo & Aquarium currently houses two breeding pairs of Asian small-clawed otters (*Anoyx cinerea*). The breeding pairs are territorial towards each other, especially when one group has detected the other through vocalizations or odor. Each breeding pair of otter has their own behind-the-scenes holding area that are down separate hallways. However, they routinely take turns residing in the same exhibits and use the same pathways.

Indian Crested Porcupines (*Hystrix indica*)

A single female porcupine had a sister who passed away a few years ago. Recently, Point Defiance Zoo & Aquarium acquired a prickle with two females and one male, but we have been unable to integrate the two groups. The single female is sometimes brought to the animal theater to participate in the animal presentations. This single porcupine is one of the easiest animals to shift through the system. In fact, if the need arises, keepers may shift her through keeper hallways to get her to her destination. The prickle can be more difficult if they get separated. If the keeper is able to keep them moving in the same direction as a unit, then they will be simple to shift.

The Indian crested porcupine (Hystrix indica) prickle in Exhibit 5

Lowland Anoa (*Bubalus depressicornis*)

A breeding pair of anoa are managed at Point Defiance Zoo & Aquarium, but not together. As solitary animals, they are only in the same space with each other when it is time to allow them to breed. Anoa are known for being aggressive, so both anoa have dog kongs attached to the end of their horns to prevent injuries during breeding introductions. While keepers can set up breeding opportunities in the behind-the-scenes holdings, the most successful breeding attempts have been in one of the meshed exhibits.

Northern White-cheeked Gibbons (*Nomascus leucogenys*)

Point Defiance Zoo & Aquarium has a non-breeding male and female pair of northern white-cheeked gibbon (the female underwent an ovariohysterectomy a few years ago). The chute system has bars

attached to the roof for both species of gibbon to use, allowing them to brachiate if they choose. The northern white-cheeked gibbons and the siamangs demonstrate territorial behaviors towards each other. The location of both groups greatly influences the success of the shifts. The white-cheeked gibbons shift more easily when they are aware of the whereabouts of the siamangs.

Siamangs (*Symphalangus syndactylus*)

A non-breeding pair of siamangs call Point Defiance Zoo & Aquarium home as well. When shifting, the female prefers to use the bars to brachiate while the male, who is geriatric, prefers to walk. This means that the female will usually move through the chutes faster. The siamangs are not as quick as the white-cheeked gibbons, allowing doors behind the pair to be closed more easily and their movement through the chutes to be tracked with more certainty.

Tigers, Malayan (*Panthera tigris jacksoni*) & Sumatran (*P. t. sumatrae*)

Currently, there are seven tigers in the collection at Point Defiance Zoo & Aquarium split into three streaks (groups). A mother tiger and her three cubs make up the largest streak, a pair of three-year-old males are another streak, and a single two-year-old tiger lives by herself. To house this number of tigers, the chute system is used as extra holding space overnight and during the day as needed.

Three Sumatran tiger cubs (Panthera tigris sumatrae) investigate water in Exhibit 2 for the first time.

The mother tiger and her cubs must have at least two closed and locked doors between them and the other groups of tigers. The pair of males and single female may have a single closed and locked door separating them. All tigers may be housed near each other. However, the mother tiger and single female

will consistently pace when housed in their line of sight. To prevent unnecessary pacing, they are housed further apart when possible.

In general, all tigers are fed their meal at the end of the day. Exceptions made would include saving all or part of their diet for training sessions and any medications that may be more than once a day. Before feeding a tiger can occur, they must be separated if they are in a streak.

Wrinkled Hornbill (*Aceros corrugatus*)

A single female wrinkled hornbill is housed at Point Defiance Zoo & Aquarium, and is arguably the most difficult species to manage in the rotational exhibitry system. She is imprinted and is very interactive with people she knows. She cannot fly well and does not shift through the chute system. All four career keepers spend many hours of training with her throughout the year, and all of the training is needed to manage her. She must be crated and carried to and from the exhibit. This can only be accomplished on days with two or more career keepers.

Challenges of the Asian Forest Sanctuary

Intra-species Challenges

Both pairs of otters may go to any of the exhibits. This means that each pair will detect the other at some point. When an otter pair enters an exhibit, they look for any trace of the other animals, particularly the other otter pair. If the scent of the other otter pair is detected, excited vocalizing and scent marking follow. Sometimes the other otter pair will be exhibited nearby, so if the other otter group detects vocalizations, they will vocalize back and proceed to scent mark. When shifting either group of otters, the other pair must be out of sight or the pairs will display territorial behaviors towards each other for quite a while.

The porcupine may go to any exhibit except the Dayroom. The two groups of porcupine are familiar with one another and will default to a defensive state if they cross scent paths. Though introductions have been tried, these four porcupine will have to be managed as two separate groups.

The anoa may go to any exhibit. The anoa can be the most difficult species to shift in this system. They must walk up steep slopes that may become slippery in rainy weather, and move through the chutes at their own pace. Due to their lack of urgency to move through the chutes, keepers will leave the anoa with access to their chute pathway and come back later to check their progress. Thankfully, the female anoa is highly food motivated, which facilitates shifting her through the facility. The male anoa is not food motivated at all. The keepers figured out very quickly that shifting the anoa is more successful when the female is allowed to go first. Once the male sees her leave, he then becomes motivated to shift (with the hope of meeting her in the same exhibit).

The northern white-cheeked gibbons and siamangs may go to Exhibit 2, Exhibit 3, Exhibit 4, and the Dayroom. When shifting, the white-cheeked gibbons move very fast, and most of the time they shift together. However, if they split apart while shifting, the process becomes much more difficult. Closing doors behind the gibbons as they move along the path is usually a good way to get back on track. Due to their speed, certain doors can act as check points for the keepers who are trying to keep track of both animals. Both white-cheeked gibbons can pull open the doors in the chute system, especially the male, so locking the doors after closing them during the shift is the best option. Often, the siamang pair will refuse to shift. The reasons seem to be mostly weather-related with emphasis on cold outside temperatures (preferring to stay in a warm, dry room) and warm, sunny days (preferring to remain basking in the sun).

The tigers may go in all exhibits except Exhibit 5. Often, shifting a tiger or streak may be the first shift completed in the morning. This is easy to do as they usually already have access to at least part of the chute system. However, multiple tiger streaks may have access to part of the chutes, so some tigers may have to be locked out of the chutes before the first shift can take place. If any tiger is uncooperative for any reason, this has the potential to halt all shifting in the Asian Forest Sanctuary.

Due to the specific exhibit requirements of the hornbill, she may only be exhibited in Exhibit 2. Since she is sensitive to cold temperatures and rainy weather, she can only be exhibited during the summer months. However, the summer months often do not have enough staff to move her between the exhibit and her holding area. The keepers have also flight trained her in hopes of helping her build muscle to move through a large meshed exhibit. She is only able to go to one of the meshed exhibits which has two walls of glass. Through experience, she is aware that she cannot fly through the glass windows. However, because she is not in shape for flying, she cannot turn easily and has difficulty reaching higher perching in a timely manner once grounded.

Inter-species Challenges

Each otter pair may be exhibited with the single porcupine and female anoa, but not with the other group of otters. The male anoa will attempt to stomp on the otters if they come near him. The female anoa will only warn the otters if needed. The otters also head the warning of the porcupine and have no interest in any of her food.

The single porcupine may be exhibited with either group of otters, either of the anoa, and either species of gibbon, but not the prickle of porcupines. As of September 2015, the prickle has not been introduced to another species. When exhibited with a primate pair, the single porcupine ventures out to the exhibit at least 15 minutes prior to the primates' arrival to allow her time to eat her morning meal.

The female anoa may be exhibited with either otter group, the porcupine, or either species of gibbon. The male anoa may be exhibited with the porcupine or either species of gibbon. The anoa are usually shifted after the other species has already arrived at the exhibit. This is mostly due to timing as the anoa move at their own pace.

A pair of Asian small-clawed otters (Anoyx cinerea) sharing Exhibit 1 with the single Indian crested porcupine (Hystrix indica)

The northern white-cheeked gibbons can share their time on exhibit with either of the anoa or the porcupine. If the porcupine is to be exhibited with them, then the porcupine will be moved to the exhibit first. This allows for her to eat her morning diet and get settled in before the primates join her. The white-cheeked gibbons exhibit well with her. If either anoa will be exhibited with the primates, then the primates will usually be in the exhibit first. It would be easier to shift the anoa out first since they will be less likely to come back in the chute system when the door reopens. Due to the time constraint of having to have primates out by the opening of the zoo and the leisurely speed at which the anoa usually shift, the order is usually done as primates first and anoa second. When the white-cheeked gibbons are in the exhibit, the final door will remain closed until the anoa is right in front of it. The doors behind the anoa will be closed and locked before opening the exhibit door. Predictably, the white-cheeked gibbons will greet the anoa at the door once it is open. The female gibbon may look at the anoa up close and may touch the anoa's face or body. The male gibbon will brachiate down past the anoa, test the shift door, and land on the back of the anoa. Keepers have witnessed the male gibbon sitting on the back of the anoa as the anoa steps up the ramp into the exhibit.

Even though anoa (Bubalus depressicornis) are known for being aggressive, this male anoa allows for interactions from the male and female Northern white-cheeked gibbons (Nomascus leucogenys).

The siamangs may be exhibited with either of the anoa and the single porcupine. The anoa and porcupine have to be shifted similar to the Northern white-cheeked gibbons. The siamangs have not been observed to have as direct contact as the white-cheeked gibbons. Also, the siamangs will sometimes grab at the porcupine's longer quills and may have to be separated from the porcupine earlier than otherwise.

Only two species in the Asian Forest Sanctuary may not be exhibited with other species. The tigers are not exhibited with any other species for obvious reasons. Due to the lack of flying skills of the hornbill, she currently cannot be housed with other species. In the future, it is the hope of staff that the hornbill may be exhibited with the anoa and perhaps the porcupine.

Safety in Shifting

As a general rule, each tiger must have at least two locked and closed doors in between themselves and another tiger or species. However, due to space limitations, an exception may be made if the situation arises. In those situations, the decision will be left to best judgement of the keeper(s). Before any animal is shifted through the chute system, the keeper opens doors to set the pathway the animal will shift through. This is done by opening doors that start where the animal is going to where the animal currently is. Before the final door is opened letting the animal through, the keeper will double check that all the correct doors are open and others closed. The animal is then sent through the pathway. Often, a second keeper will receive the animal at its destination. This second keeper may be a part-time animal keeper or intern. During the shift, the keeper will often choose to close doors as the animal passes through them, which encourages them to move forward. Once the animal is secured at its destination, all doors will be closed before setting the new pathway for the next animal. If more than one keeper is working the area, all keepers will communicate the intentions/process of shifting. Each day there are multiple keepers, a keeper is chosen to be "primary" during shifting. This keeper makes the decisions for the next shift.

Benefits of the Rotational Exhibitry of the Asian Forest Sanctuary

Animals

All of the species that reside in the Asian Forest Sanctuary are cognizant of the other animals that have been in an exhibit and display behaviors that demonstrate this awareness. The male anoa is constantly seeking the female anoa and the female anoa regularly seeks food. The primate pairs are constantly on the look-out for the other primate pair, and depending on where the other pair is, they may display territorial behaviors towards one another. When the tigers enter an exhibit, they check favorable territorial markers in effort to discover who had been in their territory. Many of the tigers enjoy discovering that the porcupine had passed through. Once a tiger has discovered the porcupine odor, they may begin rolling in the area. If they discover another tiger had recently been there, they display a flehmen reaction and will remark the spot with urine. If the tigers are unsure of where the other tigers are, they will often be observed vocalizing throughout the day.

The tigers also spend considerable amounts of time watching the other species. Both the porcupine and the otters are quite active, and appear to catch the interest of some of the tigers for long periods of time. When the tigers are in view, the anoa will lift their heads, demonstrating aggression towards them. The wrinkled hornbill shows interest in watching all the other species. When it comes to inter-species interactions, the animals will all have different experiences. For instance, the female anoa will have a very different day when exhibited by herself compared to when she is exhibited with an otter pair or primate pair. This system of various exhibit options combined with experiencing each exhibit differently depending on the combination of species is considered built-in enrichment for the individual animals.

Visitors

The theme of Asian Forest Sanctuary is realized through rotational exhibitry. While heavy animal use has taken a toll on most of the plant life in each exhibit's habitat, the species themselves are displayed in a way that may convey an entire ecosystem. Even though these species in particular would not live in the same location, visitors may get a sense of different Asian species co-existing. Due to the built-in enrichment of the rotational exhibitry, there are more opportunities to see the species demonstrating a higher degree of various natural behaviors other than sleeping. During the spring and summer months, many species may be shifted around during the day, meaning that visitors could walk through the Asian Forest Sanctuary in the morning and see a completely different rearrangement of species if they come back through the Asian Forest Sanctuary that same afternoon.

Keeper Staff

While the flexibility of the Asian Forest Sanctuary is the highlight of the area, they system as a whole is more challenging than traditional shifting. Safety is the number one concern, but timeliness is critical in the morning and evening. The needs for the morning and evenings change daily. In a way, the keeper staff have to play a game of chess to make everything the most efficient. Some things that may change the keeper's plans include animal medications and supplements, zoo education programs and tours, neonate care, geriatric care, sudden needs from the animals (apparent illness or injury), needs to place certain animals or animal groups in specific exhibits, and limitations of part-time staff and interns. The only consistent challenge for the keeper staff is to have a tiger and primate group in an exhibit from the time the zoo opens and closes.

As challenging, stressful, and complicated as the area can be for keeper staff, there is a high satisfaction factor when challenges are met. Sometimes the keeper's plans will have to change if the animals decide not to cooperate or if they have sudden needs. The unpredictable aspect of the rotational system makes the Asian Forest Sanctuary an exciting place to work!

Acknowledgements

The help of the entire team in the Asian Forest Sanctuary is invaluable. I would like to thank all of the other Staff Biologists Christy Webster, Natalie Davis, and Telena Welsh. I would also like to thank all of the Zoological Aides in our area including Lauren Sutherland, Jessica Bartlett, Michelle Lanteigne, Megan Ohlrich, and Julie Richardson, as well as our current interns Mandy Petrie and Lexy Woods. Finally, I would like to thank our General Curator, Dr. Karen Goodrowe Beck for all of her assistance.

Itching to Enrich- How CZBG made enrichment programs a more manageable priority

Colleen Nissen, Cat Ambassador Trainer

Cincinnati Zoo and Botanical Garden

Cincinnati, Ohio

Whether it is monetary restraints on budget, or simply not having enough hours in the day, most zookeepers are constantly facing a myriad of challenges while still giving optimal care to their animals. While enrichment is critical for animals' wellbeing, it is often the first to be sacrificed in the name of saving time in the busy keeper workday. Also, without an abundance of resources it can be a struggle to maintain a standardized, top quality enrichment program within a collection. Keepers might struggle with making enrichment easier and more accessible or breathing new life into a current enrichment program to encourage more creativity and enthusiasm amongst fellow keepers. At the Cincinnati Zoo and Botanical Garden we have tackled the challenge and have developed some creative solutions through organization and creativity. We have taken enrichment from a quick afterthought in the daily routine to a standardized and manageable program that benefits our animals, their keepers, and the zoo guests. This presentation will share the strategies the CZBG enrichment committee has developed to change how our keepers, volunteers and our visitors are engaging with our animals' enrichment programs. This presentation will also share how our animals have benefitted from streamlining our protocols, maximizing our limited resources, and increasing our innovative ideas. Tips, tricks, and ideas that have been successful in enriching some of the most challenging species will also be shared.

It seems intuitive that increasing accessibility leads to a proportional increase in use. One thing that most zoos would like to increase, whether it is from the perspective of keepers, supervisors, visitors or administrative staff alike, is the use of enrichment. Enrichment increases the livelihood of the animals it is offered to and decreases stress and stereotypic behaviors. It gives zoo visitors an opportunity to see animals active and engaging in natural behaviors. Enrichment programs can be a reflection of an institution's commitment to animal welfare. It can be an excellent resource in our fight to express that dedication to those who may think negatively regarding captive animals. However, without stringent or mandatory regulations, enrichment can also be one of the first to drop in priority as a busy workday mounts. The answer to increasing enrichment use at the Cincinnati Zoo and Botanical Garden was to find creative ways to make our enrichment more accessible. We are finding ways to help make enrichment items more accessible to keepers, increase ways for volunteers and visitors to become more involved, and making educational information pertaining to enrichment more readily available to our patrons.

As zookeepers, we want to give our animals the very best of everything, including enrichment items. When the days are stretched thin, it can seem to be a daunting task to conceptualize and build a large scale, time consuming, or complicated enrichment item. To ease the workload for keepers, the Cincinnati Zoo created a group of volunteers who meet solely to tackle such enrichment projects.

The Animal Enrichment Volunteer Pilot (AEVP) consists of about 15 of our volunteers who excel in creativity and craftsmanship. These volunteers range in age and expertise with backgrounds in carpentry, graphic design, and architecture to name a few. The goal is to create high quality and low cost enrichment with a quick turn-around for production in a safe, on-site environment. Our group has not only developed new enrichment designs, but has also made cost comparisons to items routinely purchased by our animal

departments. For example, it was found that a rhino feeder that had been purchased in previous years cost $80 to buy, but only $25 to make. Similarly, animal hammocks that range up to $800 can be made for closer to $150. Standardizing parts and keeping an inventory of materials makes for an effective way to cut expenses and rather than covering labor costs monetarily, volunteers are compensated with novel zoo experiences, such as behind the scenes tours and animal encounters.

While this program is apparent in its benefits to the animal keepers and the animals in our collection, we have also made it an interpretive learning opportunity for our visitors. Our AEVP on-site workshop is within the visitor access path and volunteers are trained on guest interaction talking points. They are encouraged to engage guests in conversations about why enrichment is important and what projects they are currently working on. There is also visible signage and informative animal facts as it pertains to the projects and the program. The focus on visitor engagement mirrors the CZBG core values and it helps guests understand the totality of what zoos are trying to accomplish with top-notch animal care. With a better understanding of enrichment, our zoo visitors can develop an appreciation and an even deeper support for zoological institutions.

Following the trend of visitor engagement and making enrichment more accessible to our guests, the CZBG team has also started a prototype program for offering enrichment viewing tailored towards individual guests' interests and schedules. The concept is a menu based add-on that visitors can purchase via the zoo's website when buying their zoo tickets online. Guests can choose from a variety of novel enrichments for a range of different species to be presented at designated times on their visitation day. Patrons can request a special "shout-out" during their purchased enrichment viewing time. Although other members of the zoo public can be onlookers, there is a sense of ownership and involvement from the purchaser. Both the website information regarding this program and the presentation of the purchased enrichment allow for a learning opportunity for our visitors to better understand "the how and the why" behind the benefits of enrichment. Additionally, it is made clear where the money spent on the add-on enrichment opportunities is allocated; all funds from these purchased opportunities by the guests are designated to the CZBG Enrichment Committee's budget to further animal enrichment throughout the zoo.

Another way for zoo patrons and supporters to get involved is to donate enrichment items. Toys, feeders, and other keeper requested items can be purchased from an Amazon wish list, easily accessed through the zoo's website, which lists enrichment requests from various animal departments. This gives our guest a tangible way to feel a sense of involvement in their favorite animal's wellbeing and a connection to their zoo through a physical contribution.

Encouraging an increase in volunteer and visitor involvement as it pertains to enrichment has no doubt had a positive effect on our keepers. However, even with the benefits of these initiatives, this means very little if there is not a goal set for bettering our animals' lives with our new resources. As a way to standardize a high, but attainable goal, each animal area was asked to revisit their enrichment protocols. We began to streamline how our enrichment protocols were formatted and objectives for increasing enrichment minimums were pushed. The CZBG enrichment committee came together to tackle past setbacks and strive for more enrichment offered more often. These goals are revisited annually, and the committee works together to ensure that these standards are upheld.

Keepers and zoo staff are beginning to see progressive changes in our enrichment programs and get excited about the increase in our animal interactions. This, coupled with the positive reception from the visitors as it pertains to enrichment, has led the way for innovative and creative ideas to surface. While some of these ideas are still in the stages of working through logistics and awaiting official approval, there is still value in sharing them. "Enrichment Forwarding" is one such idea, where we partner with smaller organizations (i.e.: animal shelters or rehab centers) to donate used enrichment items that can still

be used but may have cosmetic flaws or have lost their novelty for the zoo's collection. This spreads the initiative to make enrichment more accessible by gifting to an organization with smaller staffing, budget, or resources. By the same token, an idea for an "interdepartmental enrichment swap" was posed. With overlapping taxa throughout different departments of the zoo, this could be a way to share enrichment successes, repurpose failures, and increase rotational novelty of items.

Another idea in progress is a publicized, non-naturalistic enrichment day. The idea comes from the struggles surrounding on-exhibit animals and their limitations in only giving naturalistic enrichment items. Keepers would have one day to organize brightly colored objects, recycled materials, and otherwise non-commonplace enrichment on-exhibit on a monthly or bi-monthly basis. Signage and social media would explain to guests the concepts and benefits of enrichment. Also, a focus would be set on allowing the visitors the opportunity to clearly identify what is given to the animals as enrichment, rather than having it blend in to the enclosure or be looked over due to the items' camouflaging colors.

We have been able to recently implement the zoo-wide celebration of "Enrichment Day", a similar endeavor for visitors to learn about the subject of enrichment. "Enrichment Day" is marketed through our social and broadcasted media as a day for guests to come and learn about the subject and participate in an interactive way as they navigate through our zoo, exploring each facet of our zoo's enrichment program. The day's keeper chats and animal encounters were geared around this central theme and the animals' interactions with their enrichment were highlighted. Stations were placed throughout, to either make simple enrichment items or to discuss the different categories of enrichment (i.e. sensory, nutritional, etc.) with activities and tangible items for each. To encourage interaction between staff and visitors, we set up a scavenger hunt style question and answer game. The visitors would receive a paper with various questions (ex. "What do the zookeepers use to recall in Hydra, the capybara?) To receive the answer, they went to the station that discussed training enrichment and talked with the volunteer there. Once they received the answer (ex. "a whistle") and collected 3 out of the 4 answers, guest could submit their answer card for a chance to win an enrichment themed prize in a raffle. Additionally, we had foraging puzzles and cooperative feeders, stocked with candy, that guests could manipulate and explore while waiting in the long lines of the train or carousel. We united the day with the color purple; informational signage, staff's t-shirts, and even toys and objects in the animal exhibits were purple so that the visitors could identify the special festivities.

One thing that we learned while exploring ways to grow and improve how we connect both animals and people with enrichment is to not undermine the power of social media. It can be an easy tool to reach the general public for promoting what an institution is doing with its enrichment program, whether it be emphasizing an exciting idea or endorsing a special event (i.e. holidays, animal's birthdays, etc.). Using social media as a way to network with other institutions has been an exciting way to build our programs. Perusing idea board sites, such as Pinterest, has opened up a world of enrichment for a variety of different species. Also, being active on forums, for example "Zookreepers" on Facebook, has given our committee new ideas and perspectives. Both of these sites have helped gain ideas for animals that seem difficult to enrich, by learning from others who have found creative ways to play to their animals' natural interests. We have even found ways to use natural history and enrichment to exhibit our animals during visitor encounters. For example, using a pegboard to showcase an arboreal snake species for a presentation or a foraging bin to occupy a bat-eared fox during a chat.

In summation, we have found that through our efforts to make enrichment more accessible we have developed a more robust and flourishing enrichment base for keepers, animals, volunteers, and visitors alike. We have made enriching our animals a more manageable priority and have allowed for our guests to be better informed and involved as our zoo programs grow. Albeit some of our ideas have been recycled and borrowed or tweaked from other successful institutions, we find value in sharing triumphs to achieve the goal of providing the best overall care to our animals and inspiring guests in the process.

With those missions in mind, our hope it to spark initiatives in other zoos so that we can all strive towards having bigger and better enrichment programs in the future.

Evolution of the Guest Enrichment Activity at Disney's Animal Kingdom Lodge

Jessie Schrauger, Keeper II and Mary Ann Cisneros, Keeper II

Disney's Animal Kingdom Lodge

Lake Buena Vista, FL

Disney's Animal Kingdom Lodge offers a unique opportunity for guests to prepare animal enrichment for its collection, which consists of African hoofstock and birds. This Guest Interaction (GI) has evolved over the years for various reasons. The most recent change is its biggest yet, because it was fueled by frequent guest feedback citing a desire to see the animals actually interact with the enrichment. In response to this, we sought to solve this issue by changing its location to a new savanna. This meant implementing a series of logistical changes, as well as dedicated preparation and teamwork among keepers and educators that ultimately allowed for the activity to thrive.

Before its big change in 2015, the GI occurred on Arusha savanna, an 11 acre mixed-species exhibit (Table 1). The basic set-up involved:

1. Delivering enrichment devices and fillers to the Education team by 1030 hours.
2. The Education team (savanna guides) leading guests in making enrichment from 1130-1200 hours.
3. The Arusha keeper meeting guests and guides to thank them for their help and answer any questions they might have at 1145 hours.
4. The Arusha keeper putting out enrichment devices on the closing run at 1700 hours.

The biggest issue with this set-up was the time of enrichment distribution, since guests were unable to see the fruit of their labor right away. It was necessary to have a later distribution time due to a history of competition over the enrichment items that turned into aggressive interactions, mainly between the red river hogs and other antelope species. When the red river hogs were shifted into their holding yard for the night at 1700 hours, keepers were then clear to distribute enrichment. Although this was in the best interest of the animals, it was seen as a missed opportunity to reward guests with the full experience of seeing animals interacting with the enrichment. From an education standpoint, we were also missing the chance to discuss the resulting animal behavior with the enrichment. With the need for change, Animal Care managers asked us to come up with a way that would allow the activity to run full circle, and allow guests to not only see the building stages of the enrichment, but also how different animals reacted to and utilized the devices in different ways.

Initially, interested keepers met to outline the goals of the enrichment activity, as well as discuss the timing of the GI, options for location, species that might have a negative impact (hogs), logistics with partnering teams (education), and keeper and animal routines. We also met several times with Education coordinators to make sure we were all on the same page. It was imperative in these early stages to know that the changes would work for both of our teams, and be able to brainstorm ideas with one another as well.

The original timing of the interaction was not seen as an issue, since animals had already been shifted back on to the savanna following an 1.5 hour cue-in time to the barn to receive their grain diets, medications and supplements. Furthermore, the Education team had already built this time into their schedule. However, due to the great potential for negative interactions over enrichment items, we decided to change the location of the activity to Uzima savanna, which is home to a different combination of species (Table 2). By moving the activity to Uzima savanna, we thought it would be ideal to utilize the spacious overlook that would allow guests to be up close to the savanna while preparing the enrichment. An important logistic we had to overcome was the need for a secure place to deliver enrichment items and fillers for the savanna guides to pick up. The old location on Arusha savanna utilized a locked keeper stairwell where we could leave the items. By contrast, the area behind the Uzima savanna is a high traffic area frequented by all lines of business (Figure 1). A simple answer to this was purchasing a plastic cabinet that could be secured with a combination lock that we would share with the Education team.

New set-up on Uzima:

1. Delivering enrichment devices and fillers to the Education team by 1000 hours.
2. The Education team (savanna guides) leading guests in making enrichment from 1130-1200 hours.
3. The Uzima keeper meeting guests and guides to thank them for their help and answer any questions they might have at 1145 hours (later adjusted to 1150 hours).
4. The Uzima/Arusha keeper putting out enrichment devices at 1200 hours. Since the Arusha keeper has the truck at this time, he/she assists on giraffe-specific enrichment days so the items can be hung up high.

By moving the enrichment activity to another savanna with different species, we had to alter the purpose of many of the items, and in some cases, create new devices altogether. Some devices were discontinued due to observations of animals either not being interested, or safety concerns with the potential for horns to get stuck. In the old location, for instance, hay/mulch piles contained scents, spices and produce items for the red river hogs. In the new location, these fillers were replaced with mealworms, with the devices being geared toward birds instead (Figure 6). New devices, like bamboo bug feeders, were also created for the birds by drilling holes in large pieces of bamboo. Mealworms can then be poured into the feeders so that they crawl up the rough interior and peek out of the holes (Figure 5). These were a big hit with our East African crowned cranes, although we had to help them figure it out initially by showing them the mealworms, and placing them by hand in the holes.

Although most other species did not need as much desensitization to the new materials, we did a little more preparation with the birds, as in the bamboo bug feeders with the East African crowned cranes. We also started offering them hay and mulch piles, along with our African spoonbills, Spur-winged geese, and South African and common shelducks, so we could have a better idea of what kind of response to expect, and know who would be more interested. We discovered that they were very popular with the African spoonbills, and they were soon tearing apart random hay piles on the savanna to see if they might find any mealworms. This kind of

preparation also helped us to realize that we could offer the hay/mulch piles almost anywhere, since the birds responded so well not only in front of the guest overlook, but also at the flamingo pool overlook.

Time of day proved to be the biggest challenge in preparation for the hoofstock species, since the general animal activity level was low around 1200 hours when keepers would be taking the enrichment items out to hang them. Uzima savanna cues into the barn for their diets at 0600 hours when it is still dark, and releases between 0730 and 0800 hours. Following this, everyone tends to go up near the overlook and resort for hay, then retire to their individual favorite napping spots for the next several hours. In the weeks leading up to the start of the new enrichment activity, keepers started attempting to bait animals up near the overlooks using a variety of dry treats like hay cubes and petting zoo at 1130 hours, followed by the distribution of enrichment devices around 1200 hours. We found it was sufficient to shake a bucket containing the treats, then scatter them on and around the hay pads near the overlook. Over time, more animals would get up and come to eat at the hay pads, and then stay in the area. We had the most success at first with the Ankole cattle and Somali wild ass, and then others followed suit from there. Also, we created more locations to hang enrichment devices by installing more hardware on the trees near the overlook, as well as placing more deadfall in the area to create more perching options for the birds.

The new guest enrichment activity officially began on 1 March, 2015. Over the first couple of months, we continued to help encourage animals up near the overlook, which helped to keep animals in the vicinity while guests assembled the enrichment items. They were then further reinforced when the Uzima keeper would come out on the savanna to offer the enrichment devices, and often interacted with them right away.

In anticipation of making the new enrichment activity run smoothly, we worked closely with the Education team to pin down details and discuss logistics. In February, we met with the coordinators to run a refresher course on the enrichment items. We showcased all of the enrichment devices, along with all possible filler items, and went through all of the steps to create them (Table 4). This allowed us to go over important details and answer any questions before the coordinators then went back and instructed the savanna guides, who would then be leading the activity with guests. Most of the savanna guides had already been trained on the enrichment activity, but the coordinators were also going to hold a refresher course with them that would include the new and altered items. We also created "recipe cards" with the Education team to serve as a visual reference for the new enrichment devices and how they should be prepared (Figures 2-6).

The Education and Animal Care teams agreed to stay in constant communication and provide feedback to one another that would help us stay on top of what worked well, potential issues, and anything that needed to be changed. This has only served to increase the efficiency of the GI and strengthen our partnership overall. As the primary facilitators of the enrichment activity, it has been important for Uzima keepers to maintain strong communication with one another and the rest of the Animal Care team as well. Over the last several months, it has been helpful to be knowledgeable of best practices, upkeep of enrichment items, and any issues that have come

up. As new savanna guides rotate in to the activity, one of the most frequent issues reported by keepers has been items not prepared correctly or not being ready on time. We make sure to communicate this to the Education team in a timely manner, so they can follow up with the right individuals. We also recognized that by moving keeper arrival time at the overlook to 5 minutes later, it would help savanna guides to finish the activity with guests in a more timely manner.

Our team also makes a point to assess what we are doing through frequent team and savanna specific meetings. At one of these meetings in late May, keepers expressed a recent decline in guests staying to observe animal interaction with the enrichment items. An immediate response to this issue was developing a sheet to better track guest involvement and animal response to the activity (Table 3). This was first put in to use on 6 June, 2015.

By addressing the need for change in the GI, we are ensuring that it will continue to thrive in the future. Despite already implementing many changes, we recognize that it can and will change again as we continuously work toward our goal of educating guests on the role of enrichment for our animals. Through this personal experience, guests essentially become a part of the Animal Care team, and gain a unique perspective in the need for enrichment and its importance in drawing out natural behaviors. By learning how we have worked to make guests an integral part of the enrichment program, we hope that other keepers are inspired to not only implement similar programs at their facilities, but embrace the inclusion of guests in the care of their animals.

Table 1 - Species List for Arusha Savanna

Common name	Scientific name
East African crowned crane	Balearica regulorum gibbericeps
Egyptian geese	Alopochen aegyptiacus
Giraffe	Giraffa camelopardolis
Impala	Aepyceros melampus
Pink-backed pelican	Pelecanus rufescens
Red river hog	Potomochoerus porcus
Thomson's gazelle	Eudorcas thomsonii
Waterbuck	Kobus ellipsiprymnus
Wildebeest	Connochaetes taurinus

Table 2 - Species List for Uzima Savanna

Common name	Scientific name
Addax	Addax nasomaculatus
African spoonbill	Platalea alba
Ankole	Bos taurus
Common eland	Tragelaphus oryx
Common shelduck	Tadorna tadorna
East African crowned crane	Balearica regulorum gibbericeps
Giraffe	Giraffa camelopardalis
Impala	Aepyceros melampus
Lesser kudu	Tragelaphus imberbis
Ruppell's griffon vulture	Gyps rueppellii
Sable antelope	Hippotragus niger
South African shelduck	Tadorna cana
Scimitar-horned oryx	Oryx dammah
Somali wild ass	Equus africanus somaliensis
Springbok	Antidorcas marsupialis
Spur-winged geese	Plectropterus gambensis

Table 3 - Evaluation for Guest Interaction

Day: M W F Date:

# of Guests at activity	# of Guests that made devices and watched animals interact	# of Guests that were at overlook and were not at activity

Hoofstock enrichment:

Species	Responded (Y/N)	How many?
Addax		
Ankole		
Scimitar horned oryx		
Impala		
Springbok		
Common eland		
Somali wild ass		
Sable antelope		
Lesser kudu		

Bird enrichment:

Species	Responded (Y/N)	How many?
East African crowned crane		
Spur-winged geese		
Shelducks		
African spoonbill		

Giraffe enrichment:

Responded (Y/N)	How many?

Table 4 - GI Ingredient List

Seeded Pinecones

1. 4-5 pinecones
2. 10 mL of honey
3. 2 trays
4. Finch seed

Lattice Cubes

1. 4-5 Lattice cubes
2. Browse
3. 1-2 flakes of Alfalfa hay

Giraffe Puzzle Feeders

1. 4-5 light brown puzzle feeders
2. Variety of produce
3. 1 flake of Alfalfa hay

Hoofstock Puzzle Feeders

1. 4-6 small PVC feeders
2. Variety of produce
3. Dry food item: Petting Zoo
4. Hay: Coastal

Bamboo Bug Feeders

1. 4-6 bamboo feeders (with small holes)
2. Container of mealworms *Enough to fill feeders to 1st set of holes
3. White bucket to hold feeders with bugs
4. 2nd container of mealworms (for keeper) to add later if needed

Sweet Potato Kabobs

1. 2 cutting boards
2. 2-3 vegetable corers
3. Sliced sweet potatoes
4. Browse

Bamboo Feeders

1. 4-6 bamboo feeders (with large holes)
2. Variety of produce
3. Dry food item: Petting Zoo
4. Hay: Coastal

Hay/Mulch Piles

1. 4-6 grass flat containers and trays
2. Container of mealworms
3. Cypress mulch
4. Hay: Coastal
5. 2nd container of mealworms (for keeper) to add later if needed

Puzzle Feeders

1. 4-5 puzzle feeders (multiple attached)
2. Variety of produce
3. Dry food item: Petting Zoo
4. Variety of scents or spices
5. Browse

Produce Capsules

1. 3-4 produce capsules
2. Variety of produce
3. Dry food item: Petting Zoo
4. Browse

Honeycomb Feeders

1. 4 honeycomb feeders
2. Variety of produce
3. Browse
4. 1 flake of Alfalfa hay

Snack Balls

1. 4-6 snack balls
2. Variety of produce
3. Dry food item: Petting Zoo
4. Variety of scents or spices

Figure 1 - Map of Disney's Animal Kingdom Lodge

Figure 2 - Recipe Card for Honeycomb Feeder

Figure 3 - Recipe Card for Giraffe Puzzle Feeder

Figure 4 - Recipe Card for Hoofstock Puzzle Feeder

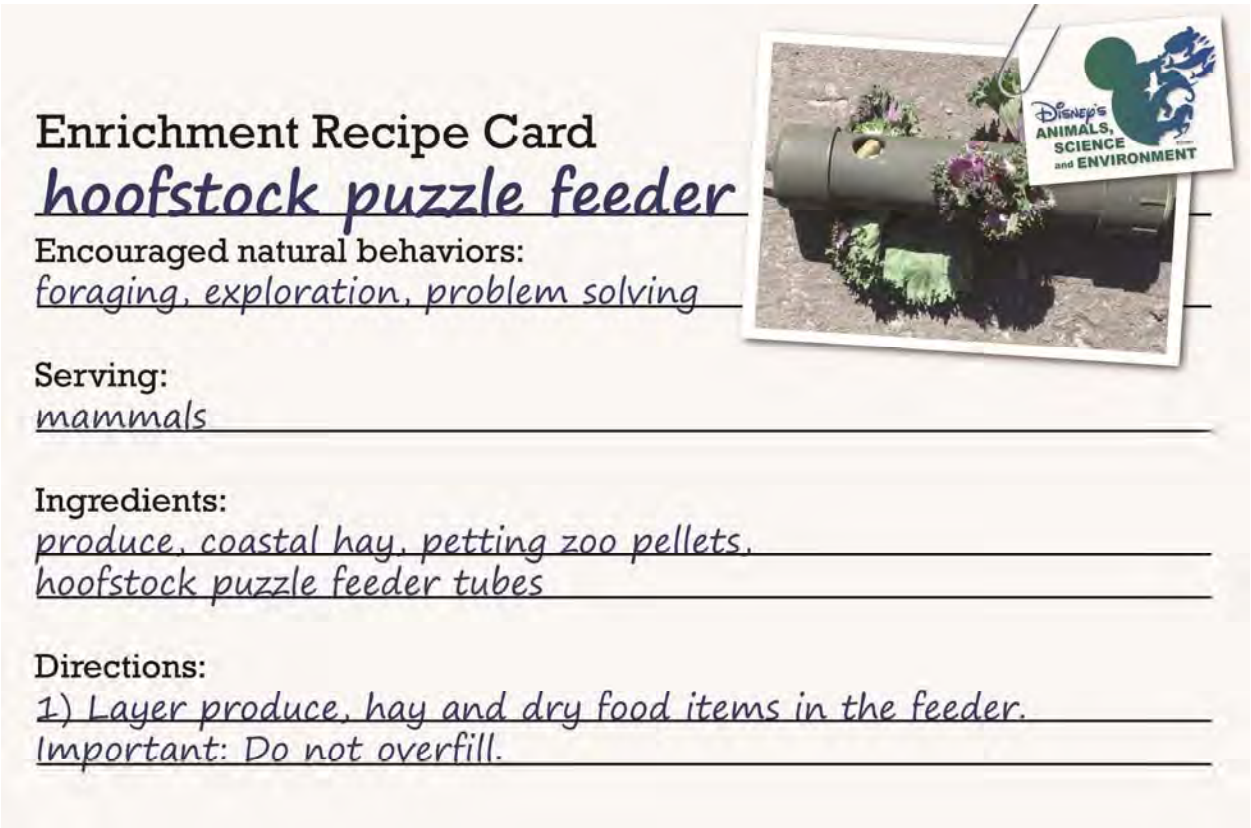


Figure 5 - Recipe Card for Bamboo Bug Feeder

Figure 6 - Recipe Card for Hay/Mulch Pile

Sire Reared King Vulture - Stay at Nest Dad

By
Kimberly Whitney, Bird Keeper II
Audubon Zoo
New Orleans, LA

Introduction

Species conservation is a primary goal among institutional members and creative solutions to common problems can be sometimes overlooked. Keepers at the Audubon Zoo were having successful breeding and egg-laying with a pair of King Vultures, but were unable to hatch and maintain viable offspring in a parent-reared environment. In 2013, a fertile egg was pulled to artificial incubation, leaving the pair with a dummy egg to incubate. Prior to external pip, the eggs were swapped for an attempted parent rearing. The egg hatched successfully, but the chick was found deceased the following morning. It was presumably killed by its Dam shortly after hatching.

It was collectively decided to try an innovative approach the following year by modifying the previous year's protocol by physically removing the Dam from the equation.

Background on King Vultures (*Sarcoramphus papa)*

The King Vulture is a colorful South American vulture with pigmentation rarely seen in scavenging birds. They display no sexual dimorphism in plumage and just minimally in size. The average weight of adult females we have had in our collection is 4.3 kg, males weighing on average of 3.5 kg. Adults of both sexes display beautiful creamy plumage with black accents, and vibrant multihued facial skin, a featherless head that benefits them hygienically (given a diet of carrion). They possess large, sharp, hooked bills and strong jaws for tearing into carcass. They rely on their excellent eyesight for survival. In the wild they spend much time soaring on air currents or perched high in trees, seeking meals. They range from Mexico to Argentina residing in savannah or forest areas. Their IUCN conservation status is Least Concern, though the threat of habitat loss is always prevalent.

The chicks are born with black skin and white down feathers. As they mature, dark grey to black feathers cover the body. Sexual maturity is reached around 4 years. As they reach sexual maturity, their drab coloration fades, and their carunkle (the decorative flaps of folded skin attached to the cere) is fully formed. While most sources list their life expectancy at around 30 years in captivity, birds have been recorded living into their late 40's.

Our Collection: 1.0 "King" and 0.1"Birmingham"

The pair I will be discussing in detail are in their late 30's and have been at Audubon Zoo since 2009. The pair have been bonded most of their life. The first recorded copulation attempt occurred in 1985 and their first egg was laid in 1990. They had not produced a viable offspring until 2013. Unfortunately, that chick was found deceased the day after hatch. Using an inventive method of rearing in 2014, the Sire successfully reared a healthy chick, the first surviving offspring for the pair.

"Birmingham" was captive born, though her rearing method is unknown. She is extremely curious and excitable. She has a reputation for interacting with staff, grabbing tools during husbandry routine, crowding and otherwise demanding attention as she sees fit. Conversely, she can also be a very sweet bird, allowing select staff to scratch her head, occasionally perform courtship displays to them. Her preference to keepers over conspecifics is suggestive to imprinting.

"King" was captive born to wild caught parents and was hand-reared. He rarely interacts with keepers, his typical primary focus being on diet or enrichment. He tends to avoid interaction with humans and other animals sharing his exhibit space.

A trait common to the pair is that both birds can become aggressive if an item that interests them is taken away, and both become territorial while incubating.

King Vultures: "King" (left) and "Birmingham" (right) with diet enrichment

The Exhibit

The enclosure where they reside is an open air exhibit consisting of two terrestrial spaces, intersected by lagoon and an elevated public boardwalk. The vultures cohabitate the north bank (along with a variety of other South American birds and mammals including Guanaco, Lowland Tapir, Capybara, Greater Rhea, Crested Screamer and a plethora of waterfowl both collection and native. The substrate is a mixture of mulch, dirt and grass with several large Pine and Live Oak trees offering adequate shade. Since the exhibit is not covered, careful attention must be paid to feather growth. They are fully flighted and their wings are checked and trimmed at the beginning of each month.

In years prior to 2014 the vultures were moved into off exhibit holding during the winter months to provide them with more adequate shelter during inclimate weather. In 2014 a barn was constructed for the vultures providing them a private sheltered area on exhibit. It was constructed adjacent to a previously existing chain link holding space. The barn was divided into two stalls; One stall opening into the exhibit, and the other into a holding area. A plastic Petmate® Indigo Dog House igloo shelter was placed in the barn prior to the onset of breeding season for nesting purposes.

The Plan

In order to make the best out of the 2014 breeding season, our department brainstormed solutions to the prior year's concerns. In 2013 an egg was laid mid- January and artificially incubated while birds were provided with a dummy egg. When the chick externally pipped in the incubator it was moved back under the incubating parents (Mid-April). This chick was found deceased the following morning. Possible reasons for the infanticide may have been due to the incubating pair being relocated mid-incubation for wintering. After this occurred, staff noted that "Birmingham" had lost interest in incubation. Post hatching, the chick was given back to the parents and her interest resumed intensely. It was speculated due to this circumstantial evidence that "Birmingham" was responsible for killing the hatchling.

In attempt to forgo a similar reaction in 2014, we opted to remove "Birmingham" entirely from contact with a fertile egg of chick. They were allowed routine access to the barn and given their Petmate® "igloo" to nest in. Once an egg was discovered, it was relocated to artificial incubation, and replaced it with a dummy egg (same as in 2013).

Artificially incubating the egg allows us to combat breakage and monitor development. Providing the pair with a simulated "dummy" egg encourages the birds to continue incubating in preparation for the real egg to be swapped for hatch. This year, we carefully monitored the egg and elected to move it to the nest prior to the pip stage. With the live egg in the nest, we would isolate "King" with the egg and allow him to rear the chick on his own. "Birmingham" would not be in direct contact with the fertile egg after it was pulled,

or later, the infant chick. Given the set up, she would still be allowed visual contact with “King” via the holding area next to the barn.

Reproductive Behavior and Egg Laying

Historically with this pair we observe pre-copulatory/courtship behavior beginning in late November/December. “Birmingham” will display to “King” by lowering her head to the crop, extending her wings, and breathing in an exaggerated pant. (Figure 1) At which time, if interested, “King” will approach, and attempt copulation. Once keepers observed this behavior, the igloo was placed into the barn (December 11th, 2013). We recorded their first breeding interactions on January 17th 2014. Following copulation the birds began spending more time in the igloo and an egg was found January 31st. The egg was pulled to artificial incubation and replaced with a dummy egg. As we had hoped, the vultures continued incubating the artificial egg and became protective of their barn. As the estimated hatch date approached, “King” became more territorial and aggressive; however, “Birmingham” was more easily distracted.

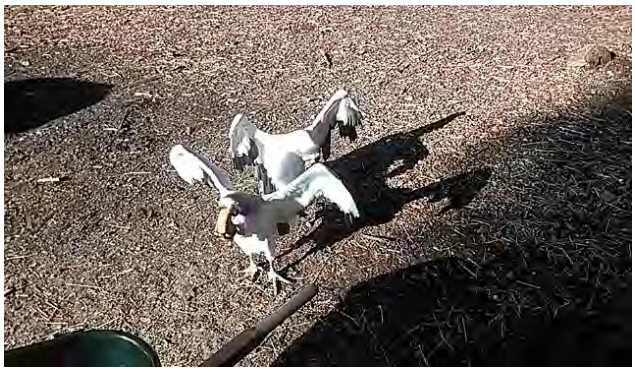


Figure 1: King Vulture Courtship Display / Attempted copulation

Hatching and Rearing

We installed a camera in the vulture barn March 21st 2014 and the live egg was moved to the nest the following day. Not only would the camera let us know when a chick was hatched with the least amount of disturbance, but would provide us with information in the event that something went wrong. While the camera was helpful, the lighting and view into the igloo was often obstructed. “King” did a great job of hiding the egg from the camera. On March 28th, we were able to get an unobstructed view of a hatched chick. We then waited to see if “King” would tend to the chick on his own. For the next few days “King” was brooding very tightly. He proved to be an excellent father and only left the nest to eat. During this time we restricted diet to large rats and rabbits only for “King” and the hatchling, to provide the most whole pieces of meat for the chick.

Figure 2: Curator Carolyn Atherton holding 0.1 King Vulture chick "Helena"

The chick's first health check took place on March 30th (Figure 2) showing a slightly discolored umbilicus, but otherwise a very healthy bird. Veterinarians continued to monitor her health and growth every 3-4 days for the first month, weighing the chick frequently. Diatomaceous earth was added to the barn as a safe insecticide for ant prevention. The chick was strong and spunky and showed distaste for the frequent handling, hissing and even biting a keeper at just a month old! As the chick was developing well, the frequency of health checks was decreased to reduce stress. The chick was DNA sexed as a female, and named "Helena". By tracking her weight during development, we can see that in the first 3 months her weight increased by 69.97% of her hatch weight (Figure 3) and exhibited linear growth (Figures 4).

0.1 King Vulture "Helena"		
Date	Weight	Growth
3/30/14	147 gm	
3/31/14	160 gm	8.84%
4/3/14	235 gm	46.88%
4/6/14	339 gm	44.26%
4/8/14	411 gm	21.24%
4/11/14	565 gm	37.47%
4/15/14	741 gm	31.15%
4/18/14	875 gm	18.08%
4/24/14	1155 gm	32.00%
4/29/14	1350 gm	16.88%
5/6/14	1600 gm	18.52%
5/13/14	1818 gm	13.63%
6/25/14	3090 gm	69.97%

Figure 3: Percent Growth for Chick "Helena"

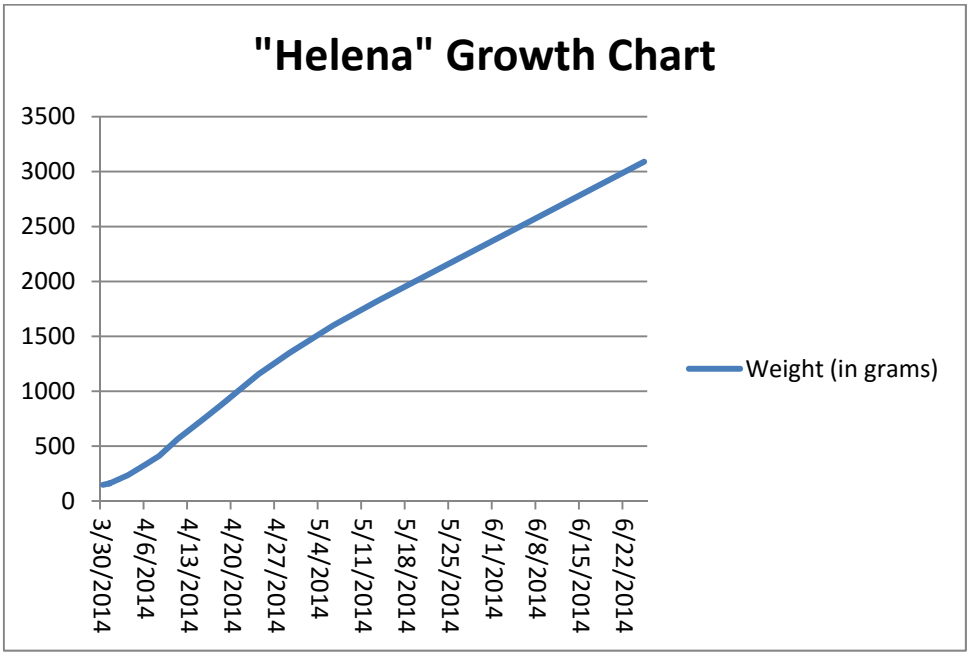


Figure 4: "Helena" Growth Chart

The bond between “King” and “Helena” was strong. She preferred his company to that of humans. On June 8th, she was first observed peeking through the doorway of the barn, retreating quickly when seeing staff nearby. By late June she became more adventurous and was observed coming in and out of the barn, into holding, to eat on her own. She continued to hiss and evade keepers as they approach. The igloo was removed from the barn and more perching was added as the bird became more independent. She began spending longer amounts of time out of the barn. During this time “Birmingham” was very curious and often came to investigate through the chain link fence.

Release into the exhibit and introductions

On August 20th she received her first wing trim and was ready for introductions into the yard the following day. “Birmingham” was very curious and followed “Helena”, making brief contact several times. “King” appeared to be disinterested in either of his conspecifics. Due to her continued interest in the chick, “Birmingham” was shifted into the barn overnight to allow “King” and “Helena” unhindered access to the exhibit. In the morning, “Helena” was found perched approximately 12 feet up in an exhibit tree! Proceeding introductions went smoothly and the birds did well together.

Conclusions and exploring some undesirable outcomes

“Helena” did not make haste in proving her abilities as an avid climber and escape artist. Even with wings trimmed it became unmanageable to allow her access to the yard while unsupervised. She was temporarily relocated to an off exhibit holding while we attempted to “Helena-Proof” the exhibit, which eventually proved unsuccessful. She was later returned and currently resides in the barn and holding area in which she was hatched and reared.

“King” began displaying a few uncharacteristic behaviors after he was released back into the full exhibit space. While he was an excellent care taker of “Helena” and seemed to be getting along typically with “Birmingham”, his tendency to avoid keepers became exaggeratedly pronounced and observed even during feeding times. When approached, he would lower his head and shrug his wings submissively. Prior to the existence of “Helena” and reintroduction into the exhibit, he would wing shrug excitedly when offered his diet, make eye contact with keepers and eagerly await his meal. In addition to the submissive behavior, he was also spending more time isolated along the fence perimeter and corners.

Conclusion

“King’s” odd behaviors have started to decrease as time has passed and are much less pronounced today. Some of our staff (myself included) hypothesize that the behavior is psychological in nature. While I can only infer with uncertainty, it appears to me that these behavioral changes were brought on by long term separation from his mate, and the singular care for a chick.

Results of this experimental adventure proved that sire rearing in King Vultures can be successful. While polyandry is seen among Avian species (typically Gruiformes and Charadriformes), it only occurs in approximately 1% of the Avian population. Attempting this innovative approach produced a happy, healthy young King Vulture. I would be comfortable repeating this protocol in the future if the opportunity presents itself.

We were prepared to repeat this procedure in the 2015 breeding season but unfortunately the pair did not lay. t is common for King Vultures to skip breeding years when a juvenile offspring is present. While "Birmingham" continued to perform courtship displays, "King" did not reciprocate interest and no breeding was observed.

Products Mentioned

Petmate® Indigo Dog House Igloo

Petmate
P.O. Box 1246
Arlington, Texas USA 76004-1246

http://www.petmate.com

References

"Avian Mating Systems." *Avian Mating Systems*. N.p., n.d. Web. 14 July 2015.

Hoyo, Josep, Andrew Elliott, Jordi Sargatal, Walter J. Bock, and N J. Collar. "Cathartidae (New World Vultures) Species Accounts." *Handbook of the Birds of the World: Volume 2*. Barcelona: Lynx Edicions, 1994. Print.

"King Vultures Aka American King Vultures." Beauty Of Birds. Web. 11 July 2015.

"Sarcoramphus Papa (King Vulture)." *The IUCN Red List of Threatened Species*. N.p., n.d. Web. 14 July 2015.

Parent-Assist Rearing of Caribbean Flamingos (*Phoenicopterus ruber)* at Riverbanks Zoo and Garden*:* A Story of Shared Custody

Christine Talleda, Lead Keeper, Zoo Atlanta, Atlanta GA
Kate Lyngle-Cowand, Curator of Exhibit Collections, Tracy Aviary, Salt Lake City UT
Colleen Lynch, Curator of Birds, Riverbanks Zoo and Garden, Columbia SC

Abstract

Traditionally, zoos have had to choose between hand-rearing or parent-rearing animals. Parent -rearing can be fraught with challenges in a zoo environment and hand rearing is sometimes thought to be the only option. In the case of flamingos, depredation in open-topped exhibits can significantly limit rearing success. Hand-rearing, however, is extremely labor intensive and lacks many behavioral benefits, including natural parent-feeding and ample exercise. To address these concerns, Riverbanks Zoo and Garden has developed a "parent-assist" rearing strategy for Caribbean flamingos (*Phoenicopterus ruber*) that combines day-time parent feeding and exercise on natural substrates with night-time brooder housing. Fresh eggs are switched with dummy eggs and set for artificial incubation. Hatched chicks are put back under the parents during the day, receiving parent-feeds and exploring the exhibit on land and in water as they grow. At night, when depredations are most likely to occur, dummy eggs replace chicks on nests, and chicks are moved to the brooder room. The next day, the process starts over again, and after a few days, dummy eggs are no longer necessary. This method keeps eggs and chicks safe from predators, and allows chicks to receive natural parent-feedings and to exercise during the day. Parent-feeding of crop milk and exercise are thought to limit leg deformities frequently seen in hand-reared flamingos while daily handling facilitates rapid observation and treatment of any veterinary concerns that do arise. Riverbanks Zoo has parent-assist raised nine chicks over four years and we continue to improve upon this process each year.

Introduction:

Since 2006, Riverbanks Zoo staff have hand-reared a total 27 Caribbean Flamingos (*Phoenicopterus ruber)*. With a prevalence of potential predators both during the day such as black rat snakes (*Elaphe obsoleta*), and at night such as raccoons (*Procyon lotor*), gray fox (*Urocyon cinereoargenteus)*, and great horned owls (*Bubo virginianus*), traditional parent-rearing was not an option, as it left small chicks vulnerable to depredation in a large open air exhibit. Hand-rearing has its benefits, but also brings along a few challenges. Each year, medical issues were observed, resulting in hospital visits and treatments including slings, wraps, or calcium supplements. Yearly improvements of the hand-rearing program were made, but ideally, chicks would be completely parent-reared to eliminate the need for formula, which might not accurately replicate crop milk. Parent-rearing would also allow flamingo chicks access to a more complex environment for exercise as they foraged on exhibit with the adults.

Flamingos have a unique natural history that keepers decided to use to their advantage. In the wild, juveniles will form a crèche, and spend much of their time away from their parents to feed. At the end of that time, chicks will reunite with the flock and find their parents by calling to them, as they are able to recognize individual calls. Bringing chicks inside at night could simulate this behavior, and parents might accept chicks again when reunited in the morning. In 2010, the parent-assist rearing method was created and implemented in order to increase the behavioral

benefits of parent-rearing and decrease the amount of keeper resources needed to hand-rear flamingo chicks.

Parent-Assist Rearing:

Nest Building and Egg Laying:

This method became successful quickly because of the detailed observations that were made by keepers during the nesting season. As flamingos began to pair off, keepers documented the established pairs and their behaviors. Each pair was recorded and observed throughout the nesting season for commitment to their nests and dummy eggs. The nesting island was mapped daily to capture the position of all of the birds to ensure that incubating birds demonstrated nest site fidelity, as pairs sometimes abandon and subsequently usurp other nests. Pairs that were attentive to their nest and dummy egg are thought to be similarly attentive to the chick, and chicks will eventually be placed only with pairs demonstrating fidelity. If a pair was not as committed to a nest, or left a nest entirely, a foster pair demonstrating fidelity would be chosen to raise their chick.

Hatch!

After hatching in an incubator, chicks are returned to the nest first thing in the morning as long as they dry, alert and active. The placement of each chick is already determined before hatch based on the behaviors of the biological parents and potential foster parents within the flock. Keepers replace the dummy egg with the dry chick before 0830 hrs.

The First Few Days:

Parents appear to bond to the chick immediately and parent feeding is often seen within the first hour, with both parents and chicks giving feed responses. Failure to observe parent feeding within the first hour may be cause for concern. Keepers and interns monitor the chick continuously throughout the day. They record feedings, monitor parental care, and provide protection from predators. Black rat snakes are prevalent at the zoo and are sometimes seen in the exhibit during the day. On a few occasions, keepers watching the chick have had to enter the exhibit to remove snakes.

Chicks are removed from the exhibit at night; keepers replace the chick with a dummy egg to ensure the parents stay on the same nest mound during the night. A brooder is set up to house the chicks overnight in an off exhibit holding space. In the morning, the chick is returned to the exhibit and replaces the dummy egg. Brooding parents do not seem bothered by this, as they without hesitation accept the egg to incubate at night, and the chick to feed in the morning. After the chick starts to move around the nest island regularly during the day (at 3-4 days old), the use of the dummy egg is discontinued and keepers simply place chick near the parents in the morning.

Day 0-14:

To optimize the amount of feedings the chick receives from the parents and negate the need for additional hand-feeding, keepers keep the chick on exhibit from 0830 to1930 hours for the 14 days. This span of time with parents results in consistent weight gains within the range seen in parent-reared birds (typically between 10 and 20% daily). Shorter “parent days” in young chicks results in lower weight gains and the need for supplemental hand-feeding at night. In previous

years, formula[1] was offered to chicks at 1930 hours when they came in for the night, but chicks rarely took much, if any. Currently, according to protocol, formula is offered only if daily weight gains are below 5%, (which is a situation we have yet to encounter). Chicks begin to eat dry pellets (Mazuri® Flamingo Breeder #5645[2]) on exhibit around day 3 and soaked pellets are offered in a shallow dish of water in the brooder starting at day 3.

Day 14-36:

At two weeks old, keepers start to bring the chick in to the brooder at 1630 hours to reduce the amount of staff overtime. Weights are taken in the morning and daily gains are calculated. As long as daily gains exceed 5%, chicks continue to come in at 1630 hours. At this age, chicks are self-feeding and are given pellets floating in a shallow tray of water overnight. When chicks become too tall for the brooder, they are moved to a larger indoor aviary where they have more room to walk around. A textured, padded mat is used over concrete flooring. Supplemental heat is offered using a heat lamp. Around 36 days of age, chicks are large enough (about 60 cm tall) to safely stay on exhibit overnight with the flock.

Flamingo Walk:

Beginning at just a few days of age, keepers encourage chicks to walk themselves between the exhibit and their night housing, which are some distance apart through public areas of the zoo. Flamingo's natural instinct to follow a flock helps with this immensely. The first year, keepers talked to the chicks to encourage them to follow. If keepers talked to the chicks while they were running in the wrong direction, the chicks would correct to follow the keepers voices. Keepers were also able to call them off exhibit from their parents when the time came to bring them inside. This made retrieving them from the flock extremely easy. While talking worked as a cue, it gave guests the impression that these birds were pet-like and failed to be a unique sound (talking staff and guests are encountered regularly whether the chick is on exhibit, off-exhibit, or in transit). The following year, we switched to a whistle but perceived this cue to be less effective. The sound was short and inconsistent with each keeper varying the note length and volume. This year, we are using a bell[3]. The bell is attached to a carabineer and worn on the belt while walking. The chick hears this sound from a very young age (about 3 days old). If the chick is walking in the correct direction on its own, we will shake the bell a bit louder. Finally, after two weeks of using the bell, on day 17, keepers stood at the perimeter of the exhibit and rang the bell. After much hesitation, but also curiosity, the chick came close enough to the fence for keepers to retrieve it, without disturbing the flock. At day 21, the chick continues to show interest in the bell, but does not walk all the way to keepers on retrieval at the end of the day. However, the chick is still able to be retrieved without disturbing the flock. At day 24, the chick would not respond to keeper with the bell at all and had to be caught with a net from the exhibit. Once caught, the chick continues to follow the keepers, even when the keepers choose

---

[1] Whole Egg Formula: mix together, 50g hard-boiled whole egg no shell, 100g hard-boiled egg yolk, 150ml water, 2g calcium carbonate, 6 ml corn oil, 1 drop of 25 IU vitamin E supplement
OR
Dry Egg Formula: mix together 50g Honeyville whole egg powder mixed with 150ml water, 174g Honeyville egg powder mixed with 226ml water. Then add: 600ml water, 8g calcium carbonate, 1 drop 100 IU vitamin E, and 24ml corn oil

[2] http://www.mazuri.com/mazuriflamingobreeder.aspx

[3] The bell used is a bell bewit, commonly used in falconry

a different path, pace or direction. This bell will continue to be used this summer as it continues to serve as an easy way for the chicks to follow the keepers.

Things to look out for:

Nest building notes:

This process would not have been possible if we did not know how attentive the pairs (and sometimes trios) were to their nests. Noting specific behaviors is very important. Does the pair stay dedicated to one nest? What is the quality of the nest? Do parents stay close to the nest when keepers enter the exhibit? This information helps indicate whether parents would be receptive to the assist-rearing procedure, or if a foster pair would be a better choice.

Feeding responses:

Sometimes, as keepers make the swap, parents will leave the nest and stand close by. Parents should show interest in the chick and return to it within minutes of the chick being placed on the nest. We also like to see that all parents are brooding and feeding the chick in turns. Chicks should give a feed response to the parents within the hour. Look for movement of the gular pouch of the parents as an indication that crop milk is being brought up. As the chick gets older, and gives stronger feeding responses, crop milk (red) stains may be seen on the chick's neck. Thorough chick rearing records will help to predict future parenting success of individual birds and pairs and to recreate keeper success and refine protocols for future years.

Heat, too much:

We only introduce newly hatched chicks first thing in the morning, as to avoid putting them out in the heat of the day. Chicks that hatch and dry mid-day are kept in the brooder until the following morning. On hot days, we will mist the island with a sprinkler for 10-20 minutes intermittently throughout the day. Parents can be seen drinking water off of their feathers, also possibly providing a source of moisture for the chicks as well. Heat is also a concern during the flamingo walks as chicks transit between brooder and exhibit. Hot pavement can burn chick's feet and care should be taken in hot weather. Additionally, if brooders are too warm, chicks will likely be lethargic and slower to exhibit a feeding response when returned to the parents.

Heat, too little:

Brooder temperatures start at 35 degrees Celsius (95 Fahrenheit) for the newly hatched chick, and is lowered ~0.55 degree Celsius (1 degree Fahrenheit) a night until the low is the same as the outside overnight low. If chicks do not receive enough heat when young, weight gains will be inadequate as chicks use calories for thermoregulation overnight. Once chicks are large enough to move to a bigger aviary, a heat lamp is provided so the chick has options to move from hot to cold.

Medical Issues:

Hand-reared flamingos are prone to developmental abnormalities and injuries of the long-bones. This may be due to nutritional deficiencies in formula (including calcium, vitamin D and inappropriate protein levels), a lack of UV light in indoor rearing rooms, limited exercise in brooder housing, or other unknown causes. The frequency of long bone abnormalities and injuries appears to have declined in the Riverbanks flock since the implementation of parent-assist rearing.

Conclusion:

The parent-assist rearing method was a success the first year and has been improved with each passing year. Since the implementation of this rearing method, Riverbanks has successfully raised 9 Caribbean Flamingo chicks. Depredation risk for chicks is virtually eliminated. Keeper time required for hand-rearing is instead spent observing the flock. Training skills are used and developed by the keepers during the flamingo walks. The flamingo flock has the behavioral and social enrichment of a complete breeding cycle. Chicks receive all the behavioral and physiological benefits of parent rearing including a natural crop milk diet, exposure to UV light, and environment that is both physically and socially complex. Zoo guests benefit by seeing chicks reared on exhibit and by interacting with the keepers on chick duty. We expect many successful breeding seasons in the future as we continue to apply parent-assist rearing methods to the Riverbanks flamingo flock and, hopefully, apply this method in our new positions at Zoo Atlanta and Tracy Aviary.

Working with What You Have; Acknowledging the Challenges that Come with Working in an Older Exhibit

Kate Marino
Carnivore Keeper
Denver Zoo

The secret of change is to focus all of your energy, not on fighting the old, but on building the new. –Socrates

Exhibit design affects everything in animal husbandry. Designs for bear exhibits of today include spacious areas filled with natural substrates, places for bears to hide or den up, play, swim and rest comfortably. They have back holdings with adequate space for training and weighing, blood sleeves built in, slap doors, self-circulating water systems, specific enrichment features, etc. While these exhibits are amazing and it is wonderful for bears to be housed in such capable holdings, what about the bears (and other animals for that matter) that are housed in less than adequate holdings? Is it possible to provide the same level of care to a brown bear in a space almost a century old to a brown bear in a space built last year? The Carnivore team of the Denver Zoo asked ourselves these questions about our oldest and most outdated exhibit, Bear Mountain. In recent years, we collaborated to create an environment in which all aspects of our animal husbandry were improved. The attitude was (and still is), if it can be done in another section, we can make it happen in Bear Mountain. Utilizing big picture thinking and optimal teamwork, the Bear Mountain team was able to make changes to our daily husbandry, as well as adding factors like unpaid internships and a comprehensive behavior study to improve the quality of care provided to the animals within this historic exhibit.

History

The Denver Zoo was established in 1896 with the acquisition of one animal, an American Black Bear named Billy Bryan. The bear was gifted to the Mayor of Denver who in turn made park workers take care of the bear on City Park grounds. There were many embellishments of the story over the years, but the best documentation of the events surrounding Billy Bryan's adventures are found within press accounts from the Denver Evening Post. This bear was the catalyst for the building of Bear Mountain, Denver Zoo's oldest functioning exhibit. Bear Mountain has stood for 97 years and is now considered a historical landmark. It has had an incredible history of changes, but there are no changes that could be made to the Mountain's original design to bring it up to standards of zoo exhibitory today. Designs for Denver's "Habitat Zoo" were created by Victor Borcherdt in 1912, but were not accepted until 1916 by the City of Denver due to Borcherdt having no political backing to push his project through. In that year, Mayor Robert W. Speer saw the opportunity for profit from the new barless zoo concept that Victor proposed to City officials which was unlike any of the cages already existing in City Park. The only other place that had this forward thinking design was Hagenbeck Gardens in Hamburg, Germany. Bear Mountain was the only section of Borcherdt's "Habitat Zoo" ever built. Bear Mountain was debuted in 1918. It took two years to build the exhibits, as moldings of Dinosaur

Ridge in Morrison, CO were created then hauled by mule back to the Denver Zoo, a trek of roughly more than 20 miles. The history of Bear Mountain is unfortunately not fully documented. A lot of changes that have occurred to the designs of the holdings and exhibits do not have exact years or drawings. A rough timeline of modifications that were recorded include the following:

> 1918-Construction completed on the Mountain which included two bear exhibits displaying natural rock formations that would be found in the bears' natural habitat, one of which contained a side cave that had potential access to a side yard. There were back holdings that ran the length of the exhibits, giving caregivers their own space to access the animals and one monkey exhibit, molded to resemble Mesa Verde attached to the east end of the mountain.
>
> 1934- Federal funds, as part of the Works Progress Administration program, created the opportunity for a log cabin to be constructed in the central bear exhibit for the bears to play in.
>
> 1967- Permanent pools were constructed in the bear exhibits.
>
> 1986-Bear Mountain is listed as a Historical Landmark by Denver's Park and Parkway System.
>
> 1987- A $250,000 grant is awarded to the Denver Zoological Foundation to perform a much needed restoration of Bear Mountain to return it to its "former magnificence."
>
> 1989- Bear Mountain is reopened with Grizzly Bears, Himalayan Bears and Coati.

As of 2015, not much has changed in Bear Mountain since it's renovations in the late 80's. It still has the same cement bunker feel to it. There is no heat within the bear holdings, no natural substrate (grass or dirt), and its dimensions have never been increased. It houses 1.1 Brown Bears (Ursus arctos horribilis), 0.1 Asiatic Black Bear (Ursus thibetanus), and 1.1 South American Coati (Nasua nasua). Although the exhibits themselves are not up to today's standards, the care that is provided to the animals is, due to the dedication to change the Bear Mountain team embraced.

The Start of Change

In 2012, Denver Zoo's animal department was taking on some major change with the opening of Toyota Elephant Passage. The TEP team was the guinea pig for a new concept of keeping at the Denver Zoo, with team run sections instead of 5 day keepers with reliefs. The team operated as a huge success. The carnivore division was soon to follow this mind set with changing its' 5 sections (Bear Mountain, Felines I, Felines II, Polar Bears and Seals/Sea Lions) to core teams. Each section, with its' own set of challenges, were taken up by carnivore keepers that had a particular passion for those groups. Each carnivore team member was able to decide on what sections were their top priority, second priority and third priority based off of what challenges they wanted to

face. Bear Mountain was the final team to be fully converted to a core team with a total of three core members.

These three team members each had their own strengths and weaknesses, as well as their own perspectives on tackling the numerous challenges Bear Mountain presented. The one thing that all three team members had in common was a strong desire to make the section better. No one wanted to hear the excuse, "We can't do that here" anymore. The team approached the carnivore management staff, Assistant Curator Steve Venne and Curator BJ Schoeberl, with an open and honest request for support in the pursuit to change this section by listening to plans and supporting team members as they tried new (and some old) ideas to improve upon the husbandry of the section. It is due as much to the openness of the management staff, as it is to the willingness to try and try again by the keeper staff that any progress was made to varying the Bear Mountain routine.

Since the section continued to operate as a 1 person run, communication was the key to the transition as ideas to improve upon the section quickly became overwhelming. Weekly meetings became a norm for the team, in which every aspect of the section was discussed in an open forum. As communication improved over the years, these meetings have reduced in frequency to either monthly or bi-monthly. Having the Assistant Curator (Steve Venne) and/or Curator (BJ Schoeberl) of Carnivores present for these meetings helped push through the agenda items that needed higher authority to be accomplished. Adding structure to the meetings helped keep the group on task as well as make sure topics did not get missed. Action items were highlighted and meeting minutes were sent to the entire carnivore group. This simple act kept the entire division in the loop with what was happening in each separate section, as well as help folks remember the action items they were assigned to complete.

In addition to weekly meetings, the core team members started shadowing each other as each ran their day in the section to help with communication. Keepers were able to exchange best practices for daily husbandry as well as observe each other's training sessions to upgrade the training program. This not only helped advance the program itself, but it gave keepers the opportunity to see how the bears and coati reacted with each other and provide constructive criticism to each other's sessions.

Finally, sharing information between all of the Carnivore sections became an incredible tool in improving animal husbandry throughout the entire division. By establishing regular division meetings to discuss overall goals and priorities, each keeper was able to see what was happening in the other sections and how it related to him/her as well as their own section. It also allowed keepers to brainstorm ideas for other sections. Thinking from an "outside" perspective helped create ideas for new exhibit enhancements as well as training techniques and enrichment items that were easily overlooked when folks were too close to the situation. For example, introducing the innovation game to the bears during training sessions was possible because of a sea lion keeper sharing that skill with the bear keepers.

Big Picture Thinking

Figuring out the role our section plays in the big picture of the Denver Zoo was crucial to accomplishing the change we were seeking. Knowing that each division, each area, is a cog in the big machine helps us visualize what affect our team has on others and what teams affect ours. Bear Mountain has a direct effect on the other divisions in Animal Care, as well as the Behavioral Husbandry, Nutrition, Maintenance, Volunteers, Guest Relations and Education Departments. Sometimes relationships between departments can feel like great collaborations, sometimes like competition and at other times stressful and tense. Additionally, the relationship between two departments will change and can reflect all three scenarios at various times.

To establish better relationships with the departments that have the most tension, we had to ask the questions, what can we do to help that department and what do we want from that department to help us? For example, Bear Mountain is one of the most challenging exhibits for volunteers to interpret to our guests. Volunteers providing guest talks would struggle with explaining stereotypic behavior and the small size of the exhibits, and would often not satisfy disapproving guests. Because of the difficulty our area provided, we rarely had volunteers offer to provide guest interactions for our exhibits. In 2013, an extensive presentation was given to the volunteers with the history of Bear Mountain, an explanation of our husbandry program (training, enrichment, behavior), and several talking points were provided for guest interactions. Since that talk, we have had many more scheduled volunteer guest interactions which relieved pressure from the keepers from performing these duties alone. In addition, the volunteers also learned of ways they could assist the keepers in our section, by providing enrichment items that keepers do not have time to make such as Papier-mâché.

Our relationship with Guest Relations is a different example of collaboration. Guest Relations is constantly looking to improve the guest experience and Bear Mountain, due to its lack of luster and shine, was never much on the radar for good guest experiences. To improve the experiences guest would have by Bear Mountain, the team started giving Guest Relations a heads up when we were planning big events, such as providing the bears with honey logs or a 4th of July picnic. Guest Relations could then advertise these events at the main gate or on social media and drive zoo attendance. This gave Bear Mountain some much needed positive exposure as well as satisfying another department's goals.

Updating Behavioral Husbandry Programs

Training and enrichment are challenges in any animal section, but are especially difficult in holdings as old as Bear Mountain. These programs were the ones that needed the most time, patience, and creative thinking than any other changes thus far with the biggest challenge of all being limited space. The team developed very specific goals of what we wanted the behavioral husbandry program to look like for Bear Mountain. We wanted to fulfill the same training expectations from our section as was expected in the other carnivore sections, utilize more mentally stimulating enrichment processes and overall extinguish the use of the phrase "it's 100 year old holding, we can't do that."

Training for the bears was the most compromised by lack of space. Utilizing only the keeper hallways to train, the bears had to either be standing on shelves that they did not fit on or sitting

at a door in which their vision of the trainer is blocked by the locking bracket. Historically the brown bears were taught limited behaviors; they knew Stand, Paw (Wave), Open, (on exhibit only) as well as Target and Injection (in the back holdings). The black bears were taught Sit and Open on exhibit. Most of these behaviors were no longer being worked when the team took over Bear Mountain. In many ways, this was a good thing and gave the team the opportunity to start out fresh. The team brainstormed and came up with a challenging idea for the Curatorial staff. The team wanted to train the bears within their own dens and not from the keeper hallway. After discussing the options and establishing new safety protocols, the team was allowed to change the location of where we would train. Instead of being in the keeper hallway, we were in the center den, the bears on either side in the west or east dens, with the guillotine doors between bear and human secured in the closed position. This new location not only provided a better position for the bears to train from, it also reaffirmed the idea that this was a whole new ballgame for training. Criteria became very important.

As when building any training program, keepers started with behaviors that were going to be easier to teach and would provide the bears with successes that encouraged their participation. Relationship building was a primary goal as well as reestablishing the bridge of a clicker. Coincidently, keepers also started the training program by only giving the bears their main diet (minus chow) during the training sessions. Free (dump) feedings were removed completely from the bears and scatter feeding/puzzle feeding was limited to chow for the initial first few months, until the bears became consistent with their training.

Not only were the bears limited by space, but also limited by the previous keepers' skills. This is not a judgement of keepers in the past, but a realization that not everyone was formally trained in the world of training. Target, which is typically one of the easiest behaviors to teach, was actually the one most difficult to reshape. The brown bears were taught target by licking peanut butter off the target poles since they were cubs. When the team started to rework the training program, they were each 11 years old. Patience was the key for this behavior to be relearned, and it was rewarded approximately 1 year later with both bears performing a standardized target (nose touching target) with duration.

As of now the brown bears know the following behaviors in their back holdings; Target, Up, Open, Paw, Nail Trim, Lean In (Injection), Sit and Down. Behaviors that are currently being worked are Light (eye examination), and Stand (on all fours). The team is also coordinating with the Maintenance department to build blood sleeves. None of the training we have done up to this point is novel or impressive in and of itself, but it is the idea that expectations for this section are now at the same level as the other sections in the carnivore division. The bears are expected to learn and the keepers are expected to keep teaching more. New behaviors continue to be taught, but primarily only in the summer months. Winter months, due to lack of motivation and natural seasonal torpor, bears are only expected to withhold maintenance behaviors.

The innovation game was a training tool introduced to the bears when a core team member went on maternity leave. A prime example of utilizing team members' strengths for the benefit of the program, the seal keeper covering the section during this three month period demonstrated how

the game could capture much desired behaviors that core members were struggling with training. The Asiatic Black Bear was very motivated in training sessions, offering taught behaviors often, and took to the game readily. Behaviors she had learned (Up, Paw, Target and Lean In) were dominating her sessions and there was little focus on learning anything new. With the innovation game, she was able to quickly add fun behaviors to her repertoire and slowed down her training sessions to a steadied pace. Behaviors that she invented herself were lay down (flop her back legs so she rested on her side), moving her mat, moving a toy, backing up, and vocalizing. She also offered Open which was a behavior that the core team was at the time working on with no success. Whenever a desired behavior is offered during the sessions, the team discusses its priority and the game is then off limits until that behavior is fully captured and transferred to another cue. Down, Sit and Open were all captured using the innovation game. It is a tool that the Bear Mountain team was ecstatic to learn and is utilized often. Not only is it fun and beneficial for the keepers, but it promotes mental stimulation that the bears are always in need of.

Although the bears took a lot of focus, the coati were not ignored in the revamp of the section. Relationship building, a simple enough procedure, changed the husbandry for this species from one of stress and fear to a fun daily keeper demonstration. The coati were worked free contact prior but no training had really taken place. They would come out on a scale to be weighed with baiting but nothing more. There was also a history of nest box aggression in the back holdings and fear whenever keepers were in the exhibit with them. Their training started in the area they were most comfortable, their back holdings. Establishing a clicker bridge, the team focused on building those trusting relationships with target training for a long time. The coati are now no longer nervous when keepers come into their space but are rather excited. They quickly became used to the new routine and are trained daily on their exhibit for a public demonstration. Behaviors they now know are Target, Scale, Crate, Chute, Stand, Spin (female only) and Jump (male only).

Enrichment was a program that has jumped by leaps and bounds for the Bear Mountain animals. Keepers wanted to encompass enrichment processes that would occupy the bears' and coati for long durations of time. Core team members brainstormed many new enriching ideas by connecting with various bear professionals at Advancing Bear Care and Bear TAG workshops as well as other keepers at Denver and other zoos. Items that were distributed prior to the section rework were very limited for many reasons. For one example, juniper was the only bedding allowed due to the plumbing in the holdings. Any other substrate essentially clogged the drains immediately. We worked with the maintenance department and installed new drain covers that allowed us to provide various substrates. Now the bears get mulch, hay, straw, paper bedding, and shavings on a regular basis. Another example is that it was not possible to provide the bears with larger plastics such as large balls, pills, discs, etc. because if they were to fall in the moat it could potentially give the bears enough height and support to climb out. We were able to start providing these larger items by anchoring them down with chain from certain points of the exhibits, giving us and the bears more options for manipulation.

The biggest change was the way the team approached enrichment. We pulled away from the idea of just giving out items, including food, and focused more on what behavior we wanted the bears to perform and what would enhance their rather sterile environment. We wanted the bears to forage, investigate, play and mark by interacting with their environment differently. Every new enrichment process was proposed with a specific goal in mind and over time we have tripled the enrichment that was distributed. Puzzle feeders have become the most successful enrichment process for bears and the team has had to work on making them tougher constantly as the bears continue to solve them quicker and quicker. The coati are inclined to enjoy scent marking more than anything else so the team has established several different ways to encourage this behavior without essentially just spraying a new scent every day.

Adding New Programs

Behavior studies are becoming more prevalent in our field today. It is universally understood that the more we learn about our animals, the better we are able to provide for their needs. At Bear Mountain, we started a behavior study for the brown bears in 2013. The Denver Zoo Behavioral Husbandry intern had been looking for a project within the zoo to complete within her internship. We suggested studying the brown bears with a focus on their stereotypic behavior. During that first summer the team created an ethogram and we ran a baseline study on the bears for several weeks. The results from this short period indicated something that we as keepers were not able to see. There was a sizable amount of minor aggression observed from the female to the male on a regular basis. The aggression, really small nuances that were easily overlooked in a day to day routine, occupied a significant portion of the bears' time when the data was compounded. The team discussed several different options for modifying this behavior and chose to establish a shifting rotation that would allow the bears' individual time on the exhibit as well as the back holding in addition to their time together. With the new shifting plan in place, the intern continued to observe the bears for several more weeks and the data demonstrated that the shifting rotation was a success in reducing the amount of aggressive behavior from one to another. Not only did the rotation reach its specific goal, it also reduced the bears' stereotypic behavior and encouraged other positive behaviors. For instance, the female brown bear was rarely seen in the pool on the exhibit, but once separated from the male, she would swim and play in the water often. The male was able to focus more on foraging and puzzle toys when away from the female rather than focusing all of his energy on her.

The behavior study has been built upon since that initial first summer, and the Bear Mountain team utilizes unpaid interns to collect data daily. At least two 30 minute observation sessions are performed at random times every day. Furthermore, the Behavioral Husbandry department selected the brown bear behavior study as a trial study for the new system Zoo Monitor. This new program allows observations to be tracked and data to be entered directly into a tablet during sessions, without having to use any hard records. Since all of the data is comprehensive, we are able to filter out specific questions we want to ask at any given time. In addition to the behavior study, we have also launched a brown bear diet study. With the help of Denver Zoo's

nutritionist, we are collecting baseline data on the bears' diets with the goal of switching the bears to a seasonal diet within 2-3 years. The team is very excited at all the possible opportunities for growth and change that these studies will provide us.

The ability to study our animals was very limited without the use of interns. The significant help received from the Behavioral Husbandry intern inspired the team to investigate additional intern opportunities. The Bear Mountain team, along with its management, was able to put in a proposal for a year-round unpaid internship position for the section. The intern gets the experience of working alongside keepers in their day to day tasks, learn about the general husbandry practices but are also required to advance their own skills by the end of the internship. Every intern is required to collect data for the brown bear study, read Smiling Bears and Don't Shoot the Dog and report to their mentor, develop their own keeper talk about coati or bears, and finally design, submit and create a new enrichment process for any species within the Bear Mountain collection. The Bear Mountain team makes sure that the intern's position is not just cleaning holdings or performing other grunt work for the keepers, but rather to learn as much as possible about what it is to be a keeper and to add more hours to the keepers' day.

The Job Continues

Dealing with older exhibits is a common problem for any zoo. Although there are always masterplans in which zoos continue to build bigger and better exhibits, it is hard to say for sure when such projects will take place. Denver Zoo's masterplan currently has an elaborate space planned for education animals in the Bear Mountain space and there are no plans to house temperate bears. It is hard to imagine Denver Zoo without its founding animal, but the reality that there will be no new exhibit for these bears honestly helped improve this program. The team decided that providing the best possible care for these animals should not be limited by the holdings or held off until something better came along. The advancements the Bear Mountain team has made in their training and enrichment have benefitted the animals' abilities to cope with change. Since we are unsure of their individual futures, these animals are now better prepared for any new surroundings or routines that may be coming their way. Every animal in every exhibit deserves the best possible care anyone can provide and the job is never done. There is always an opportunity to improve one animal's life by putting forth the effort and not letting any excuse get in the way, especially the age of an exhibit. I hope the experience we have had with the Bear Mountain animals can help inspire others with older exhibits to remember the individual animals within them and to constantly work to improve their quality of life.

Engaging citizen scientists to determine prevalence of Amphibian Chytrid Fungus *(Batrachochytrium dendrobatidis)* and *Ranavirus* at Long Branch Nature Center in Arlington, Virginia

Lauren Augustine and Matthew Neff
Animal Care Sciences, Smithsonian National Zoological Park
3001 Connecticut Ave. NW Washington DC 20008
Augustinel@si.edu
Neffm@si.edu

Emerging diseases are responsible for population declines in both reptiles and amphibians worldwide. *Batrachochytrium dendrobatidis* is a fungus that causes an infectious disease called Chytridiomycosis. There is evidence that extinctions and declines in amphibians are linked to the pathogenic, virulent and highly transmissible amphibian chytrid fungus, *Bd* (Skerratt et al., 2007). *Bd* affects the epidermal cells of amphibians and causes electrolyte loss (Voyels et al., 2007), hyperkeratosis (Brem et al., 2007) and death in susceptible species (James et al., 2009). Some species such as the American Bullfrog, *Lithobates catesbeianus*, are asymptomatic carriers of this disease (Garner et al., 2006) and have been introduced in the western United States and South America (Daszak et al., 1999) and could be vectors for this deadly fungus. The spread of this highly virulent disease is causing rapid amphibian declines in North America.

Ranavirus, a genus of Iridoviruses, is often a highly virulent cause of systematic infections in amphibians (Daszak et al.,1999; Cinchar, 2002). This disease primarily infects amphibian species that breed in standing water (Harp and Petranka, 2006) and this pathogen affects multiple amphibian hosts, both larval and adult, and may persist outside of a host for several weeks or longer (Gray et al., 2009). *Ranavirus* appears as swelling in the limbs or body, erythema, and susceptible amphibians usually succumb to chronic cell death in their organs (Gray et al., 2009). Transmission of this pathogen occurs through direct contact with infected individuals, ingestion of infected tissue, and indirectly by contact with infected water or soil (Gray et al., 2009). This virus also affects reptiles and has been seen in wild populations of gopher tortoises (*Gopher polyphemus*) in Florida (Westhouse et al., 1996) and eastern box turtles (*Terrapene carolina carolina*) in Tennessee (Allender et al., 2011) and Pennsylvania (Johnson et al., 2008). The effects of this disease are less clear than that of *Bd*, but infections are being identified in new populations and is more geographically spread than previously thought (Johnson, et al. 2008). Iridoviruses have been reported to cause high mortality in fish and amphibians (Johnson et al., 2008; Daszak et al., 1999) and disease epidemics in Chelonia (Allender et al., 2011; Johnson et al., 2008, DeVoe, Chen et al., 1999). Iridovirus has been reported as a cause of morbidity and mortality in free-ranging Eastern box turtles (*Terrapene carolina carolina*) (Goodman et al., 2013) and fish and reptiles may be reservoirs for *Ranavirus* (Gray et al., 2009). This virus also affects reptiles and has been recently linked to turtle deaths in Virginia (Goodman et al., 2013).

Although chytrid and *Ranavirus* are known to occur in Virginia (Dede Olson, http://www.bd-maps.net/), Long Branch Nature Center (LBNC) has not been tested for either disease. The goal of

this study was determine the presence or absence of chytrid fungus and *Ranavirus* in as many species as possible at LBNC. We aimed to swab individuals from eight species of amphibian that occur in LBNC*: American bullfrog (Lithobates catesbeianus*), *wood frog* (*Lithobates sylvaticus*), *green frog* (*Lithobates clamitans*), *spring peeper* (*Pseudacris crucifer*), red-backed salamander (*Plethodon cinereus),* northern *two-lined salamander* (*Eurycea bislineata*), three-*lined salamander* (*Eurycea guttolineata*), and spotted salamander (*Ambystoma maculatum*). This project incorporated the National Capital American Association of Zookeepers Chapter (NCAAZK) as a part of local conservation outreach and education program. NCAAZK members are already conservation minded individuals, but many zoo employees lack the opportunity to get in the field and conduct scientific research. Thus we hoped to provide an opportunity to conduct some much needed disease screening while educating the members of NCAAZK about emerging diseases in reptiles and amphibians.

Both of these diseases affect a wide range of amphibian species worldwide and are highly virulent, making them major global threats (Daszak et al., 1999). It is likely that chelonians may be infected by amphibians or that a common environmental source is the cause for this disease in both groups (Johnson et al., 2008). An important step in understanding these diseases is to examine their distributions and species affected. Although *Bd* and *Ranavirus* have been detected in Virginia, there are only a few published accounts and so far none in the urban Northern Virginia area. For this study we followed the non-leathal protocols provided by the San Diego Global Amphibian Disease lab. The downside to swabbing for *Ranavirus* is that there has been a 22% false-negative and 12% false-positive rate when compared to other methods (Gray et al., 2009). Our results will contribute to a larger study being conducted by Smithsonian scientists and the Virginia Department of Game and Inland Fisheries on wood frog tadpoles, (*L. sylvaticus)* at the same site.

Long Branch Nature Center is located in urban Arlington, Virginia and is home to an abundance of wildlife, herpetofauna in particular. LBNC sees up to 12,000 visitors walk through their doors annually and the 17 acre park joins up with Glencarlyn Park for a continuous 122 acres. As a nature center, Long Branch is passionate about educating their guests and committed to preserving its wild lands. This park has never been surveyed for emerging diseases and acknowledges the value in this type of research. Through collaboration this project has the potential to reach a wider scope of individuals, both at the zoo and nature center. Additionally, being partially funded by the Virginia Herpetological Society will ensure the dissemination of this critical information to their membership.

Long Branch Nature Center was surveyed several times between August 2014 and June 2015 to maximize species sampled. Individuals from 7 of the 8 species were sampled for both *Bd* and *Ranavirus*. A total of 25 people from Smithsonian National Zoological Park, Long Branch Nature Center, and the Virginia Herpetological Society came out to learn about infectious diseases throughout the course of the project. We found this project to be extremely successful. Not only were we able to conduct important disease screening at Long branch Nature Center, but we were also successful in helping to educate park guests who were visiting during our field work. The samples were submitted to San Diego Global Disease lab. Although we are still awaiting the results, the results of the larger study on *Ranavirus* were inconclusive, so we look forward to adding to these findings.

Acknowledgements:

We would like to thank the American Association of Zookeepers, the Virginia Herpetological Society and Long Branch Nature Center for funding this research. We would also like to thank the staff of Long Branch Nature Center, the National Capital American Association of Zookeepers (NCAAZK) and the other individuals who participated in this field work.

References

Allender, Matthew C., Mohamed Abd-Eldaim, Juergen Schumacher, David McRuer, Larry S. Christian, and Melissa Kennedy. 2011. PCR prevalence of Ranavirus in free-ranging eastern box turtles (Terrapene carolina carolina) at rehabilitation centers in three southeastern US states." *Journal of wildlife diseases* 47(3): 759-764.

Brem, F., J. R. Mendelson III, and K. R. Lips. 2007. Field-Sampling Protocol for *Batrachochytrium dendrobatidis* from Living Amphibians, using Alcohol Preserved Swabs. Version 1.0 (18 July 2007). Electronic document accessible at http://www.amphibians.org Conservation International, Arlington, Virginia, USA.

Chinchar, V. G. "Ranaviruses (family Iridoviridae): emerging cold-blooded killers. 2002. *Archives of virology* 147(3): 447-470.

Daszak, Peter, Lee Berger, Andrew A. Cunningham, Alex D. Hyatt, D. Earl Green, and Rick Speare. 1999. Emerging infectious diseases and amphibian population declines." *Emerging infectious diseases* 5(6): 735.

Dede Olson- USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR. http://www.bd-maps.net/

Garner, Trenton WJ, Matthew W. Perkins, Purnima Govindarajulu, Daniele Seglie, Susan Walker, Andrew A. Cunningham, and Matthew C. Fisher. 2006. The emerging amphibian pathogen Batrachochytrium dendrobatidis globally infects introduced populations of the North American bullfrog, *Rana catesbeiana*. *Biology letters* 2(3): 455-459.

Gray, Matthew J., Debra L. Miller, and Jason T. Hoverman. 2009. Ecology and pathology of amphibian ranaviruses. *Diseases of aquatic organisms* 87(3): 243-266.

Goodman, Rachel M., Debra L. Miller, and Yonathan T. Ararso. 2013. Prevalence of Ranavirus in Virginia Turtles as Detected by Tail-Clip Sampling Versus Oral-Cloacal Swabbing. *Northeastern Naturalist* 20(2): 325-332.

Harp, Elizabeth M., and James W. Petranka. Ranavirus in wood frogs (Rana sylvatica): potential sources of transmission within and between ponds. 2006. *Journal of Wildlife Diseases* 42(2): 307-318.

James, Timothy Y., Anastasia P. Litvintseva, Rytas Vilgalys, Jess AT Morgan, John W. Taylor, Matthew C. Fisher, Lee Berger, Ché Weldon, Louis du Preez, and Joyce E. Longcore. 2009. Rapid global expansion of the fungal disease chytridiomycosis into declining and healthy amphibian populations. *PLoS pathogens* 5(5): e1000458.

Johnson, April J., Allan P. Pessier, James FX Wellehan, April Childress, Terry M. Norton, Nancy L. Stedman, David C.Bloom et al. 2008. Ranavirus infection of free-ranging and captive box turtles and tortoises in the United States." *Journal of wildlife diseases* 44(4): 851-863.

Pessier, Allan. "Sampling protocol for *Ranaviruses*." http://www.sandiegozooglobal.org/images/uploads/Ranavirus_Sampling_Guidelines.pdf

Pessier, Allan. "Sampling protocol for amphibian chytrid fungus." http://www.sandiegozooglobal.org/images/uploads/Chytrid_Sampling_Guidelines_2013.pdf

Skerratt, Lee Francis, Lee Berger, Richard Speare, Scott Cashins, Keith Raymond McDonald, Andrea Dawn Phillott, Harry Bryan Hines, and Nicole Kenyon. 2007. Spread of chytridiomycosis has caused the rapid global decline and extinction of frogs." *EcoHealth* 4(2): 125-134.

Stuart, S.N., Hoffmann, M., Chanson, J.S., Cox, N. A., Berridge, R.J., Ramani, P., and Young, B.E. (eds) 2008. Threatened amphibians of the world. Lynx Edicions, Barcelona, Spain; IUCN, Gland, Switzerland; and Consercaiton international, Arlington Virginia, USA.

Voyles, Jamie, Lee Berger, Sam Young, Rick Speare, Rebecca Webb, Jeffrey Warner, Donna Rudd, Ruth Campbell, and Lee F. Skerratt. 2007. Electrolyte depletion and osmotic imbalance in amphibians with chytridiomycosis."*Diseases of aquatic organisms* 77: 113-118.

Westhouse, R. A., E. R. Jacobson, R. K. Harris, K. R. Winter, and B. L. Homer. 1996. Respiratory and pharyngo-esophageal iridovirus infection in a gopher tortoise (Gopherus polyphemus). *Journal of Wildlife Diseases* 32(4): 682-686.

If The Shoe Fits…An In Depth Look at a Common Zebra's Hoof Injury Repaired via Corrective Shoeing

Author and Presenter: Meaghan E. McCarthy, Keeper, Disney's Animal Kingdom

Lake Buena Vista, Florida

Meaghan.E.McCarthy@disney.com

Author: Melaina G. Wallace, Keeper, Disney's Animal Kingdom

Lake Buena Vista, Florida

Melaina.G.Wallace@disney.com

Introduction

In March of 2013 Disney's Animal Kingdom (DAK) was home to 0.1 common zebra (*Equus burchelli*) "Mama". Mama sustained an injury shortly after recovering from an immobilization, which caused her right rear hoof to fold forward. Knuckling over on to the coronary band caused significant damage to the tendons and ligaments in the leg. Keepers, managers, veterinarians, and specialists collaborated to formulate a treatment and husbandry plan for Mama. Over the next 6 months, she was immobilized seven times, was under the care of a farrier who created specialized shoes for her, and underwent multiple radiographs, ultrasounds, shockwave therapy, footbaths and physical therapy. While the treatment and husbandry plans were extensive, Mama was able to recover to a nearly "normal" gait. This allowed her to be relocated to a new facility in northern Florida with her herd mates in March of 2014. Throughout this paper we will detail the specialized husbandry provided by keeper staff, the custom shoes created for her and the excellent veterinary care she received.

History

Mama was a 12 year old mare at the time of the injury. She came to DAK in February 2012 along with 0.5 common zebra. They were later housed with an additional 0.6 common zebra. The herd was housed in a 2.5 acre holding pen that was comprised of grass, sand, and trees. It had sloped sides leading into grassy moats. Small holding stalls, 900sqft, were used for feeding, separating, and medical procedures. These stalls consisted of chain link walls, soil cement flooring, and a tarp structure covering approximately 1/3 of the stall.

Mama was neither the most dominant nor the most subordinate zebra in the social hierarchy of the herd and appeared to be pair bonded with a 3 year old mare, "Tiny". During the 6 months Mama was under specialized care, she and Tiny were separated from the herd. They were held

in the holding stalls described above and in 2 stalls that consisted of wooden walls and soil cement flooring. A grassy yard was also utilized at times. Separation from the herd enabled keepers to more closely monitor her progress, as well as provide her with a firm substrate to aid her recovery.

Timeline

On March 14, 2013, Mama was chemically immobilized and some light hoof work was performed. Her immobilization and recovery were uneventful. The day following the immobilization, Mama and Tiny were reunited with their herd in the 2.5 acre holding pen. Later that day keepers observed Mama stumble on her right rear hoof and then drag the tip of the hoof on the ground. The next day, her lameness became even more severe. While walking, she allowed her foot to roll over and would take several steps on the coronary band before righting it. This was observed repeatedly throughout the day lasting for five to ten steps per episode. Keepers noted that the episodes appeared exacerbated by soft or sandy substrate. In order to prevent Mama's condition from deteriorating further, animal care staff attempted to shift her into a different holding area that afternoon. However, the stress of trying to separate her from the recently reunited herd in such a large space proved to be too much and the attempts were unsuccessful.

The following morning while shifting for grain, Mama and Tiny were separated from the herd and housed in the holding stalls described above. DAK veterinary staff visually examined her and recommended housing her on a flat surface until further notice. Mama and Tiny were transferred from the temporary holding stall to a barn with soil cement and grassy yard options. A day later, they were given access to the grassy yard, hoping it would be a better surface for her injury. However, Mama's right rear hoof caught on the grass and uneven surface, causing her hoof to knuckle under several times. She was returned to the soil cement yards after approximately two hours of no improvement. Management decided to house her in a single 820sqft yard to restrict her activity. Mama was then prescribed her first round of oral pain medication. She remained on either Banamine or Phenylbutazone paste, both non-steroidal anti-inflammatory drugs, for the entirety of her healing process in an effort to reduce inflammation and provide pain relief.

Within five days of starting the medication and being housed on a hard surface, Mama's gait had improved. Her right rear hoof was knuckling under much less frequently, but was only showing a slight limp. Veterinary staff visually examined her and video documentation was subsequently sent to large animal surgical experts at the University of Florida for consultation. It was determined that Mama had most likely sustained nerve damage that would heal over time and to take a 'wait and watch approach'. The recommendation was to continue housing Mama at the barn and to give her access to a second yard, thus doubling her housing space, provided her gait did not worsen. After a week of increased space, Mama's gait had continued to improve and veterinary and animal care staff were comfortable introducing her to the grassy yard to evaluate her ability to ambulate on an uneven surface. Mama and Tiny were then allowed access to the grassy yard. While walking, Mama was observed to shuffle her right rear leg and knuckle under on to the fetlock throughout the day. As a result, the affected fetlock

became inflamed and the two were shifted back to the harder surface. Two days later, chips and cracks on the lateral side of the right rear hoof were noted, and inflammation of the coronary band was evident. There were also a few scrapes present on the hock.

After one week with no improvement, Mama was immobilized for a physical examination and radiographs of her right rear leg. A hoof wall abscess was discovered below the coronary band on the lateral side of the hoof. The abscess was addressed by a zoological manager trained in hoof work and antibiotics were administered. Veterinary staff recommended treating the abscess with a footbath twice a day. Once Mama had recovered from the immobilization, she and Tiny were given access to a hallway that ran along their yards in order to desensitize them to the hallway and initiate footbath training. Four days later, Mama was immobilized again for additional hoof work, however this time by a farrier. A custom shoe was fashioned for her right rear hoof and applied with a strong epoxy. This shoe was designed to remove pressure from the abscessed area and distribute Mama's weight evenly throughout the foot. (See Figure 1) Synthetic polyurethane shoes were applied to the other three hooves for protection from the hard surface. (See Figure 2) The following day, Mama started a 20 day footbath regimen with a diluted Nolvasan solution and she entered the footbath twice per day. (See Figure 3)

On May 11, 2013, about two months after the initial injury, Mama was immobilized again. This procedure included the farrier and DAK veterinarians. An ultrasound and additional radiographs of the injured hoof indicated excess fluid around the tendons between the fetlock and coronary band. The footbath was no longer deemed necessary, but due to the fluid in the joint, hydrotherapy was recommended. The farrier removed all four shoes and replaced them with basic polyurethane shoes. Following the immobilization, keeper staff began to desensitize Mama to a hose for hydrotherapy. The veterinarian recommended using a hose to spray down Mama's hoof twice daily for about 10 minutes per session. Mama was fed moistened beet pulp out of a bowl while keepers ran a hose onto the ground that drained onto her feet. This process was relatively successful in that she became desensitized to the running water. The hydrotherapy overall was never able to be fully implemented, as keepers were not able to apply a pressurized stream of water onto the affected area. Mama and Tiny were then given access to the grassy yard to test Mama's gait on uneven surfaces and allow their hooves and joints reprieve from the hard surface. This time Mama was able to navigate the softer surface without incident.

Within twenty days of the May 11 immobilization, keepers noted a strong odor emanating from Mama. She was immobilized on June 5, by DAK veterinarians and University of Florida veterinarians. The source of the odor was never identified, but veterinary collaboration determined ligaments on the outer side of the fetlock and those connecting the fetlock to the pastern were enlarged to 2.5 times beyond what is normal. At diagnosis, hyaluronic acid and steroids were injected into the tendon and fetlock areas to reduce inflammation and lubricate the joint. Exercise therapy was also recommended for 10-20 minutes twice daily.

On June 9, Mama and Tiny started exercise therapy. Keepers began with A to B training by calling Mama to walk in an L pattern from one end of the grassy yard to a door at the bottom of a soil cement yard. She was rewarded with a mixture of beet pulp and sweet feed. Mama did

not consistently participate in the training, but she still exercised by walking around the two yards. The initial session lasted 15 minutes, and Mama walked approximately half of the time. Tiny was allowed access, but decided not to participate in the training session. Two days later, management allowed Mama to have a larger area for exercise. Keepers encouraged Mama to walk into a wide, dirt corridor by placing bowls containing a few bites of beet pulp and sweet feed in several sequential locations. The corridor was approximately 213 feet in length and 11 feet wide. Tiny was also allowed access since Mama was unwilling to shift alone. This was done daily with varying success due to many distractions and spooking occurrences. Over the course of a week, Mama and Tiny became accustomed to the training and would venture down the corridor calmly, spending approximately 30 minutes exercising daily.

At the end of June 2013, Mama was immobilized for additional hoof work. The farrier reported the previous abscess site was healed, but the hoof would take 10-12 weeks to re-grow completely. The tendons in Mama's right rear leg were now in need of attention. He constructed a wedge-like shoe that would encourage the muscles and tendons along the anterior and posterior aspects of the canon to stretch and lengthen. A shoe was also applied to the left rear hoof to provide balance when walking and standing. The existing exercise program of 30 minutes a day was continued.

At the beginning of August 2013, Mama was immobilized for a physical examination and hoof work. Basic polyurethane shoes were applied to all four feet by the farrier. The ligaments in the right rear leg were palpated and evaluated via ultrasound by DAK veterinarians as well as an equine lameness and imaging specialist from the University of Florida. Additionally, shockwave therapy was administered to the area. In horses, shockwave therapy is used for the treatment of musculoskeletal soft tissue pain and disorders. Sessions provide relief of acute and chronic pain. Equine shockwave therapy also restores mobility and promotes faster healing by stimulating bone growth, tissue regeneration and the release of endorphins.[1] The veterinary team gave approval for a larger exercise space. After being housed at the barn on soil cement with a sod yard, Mama and Tiny were introduced to a large, gradually sloped pen at the end of the corridor, known as the catch pen. The pen had an average gradient of approximately 8% (or 4 degrees.). Mama appeared to have difficulty navigating this incline and began favoring the left rear leg. Despite pain medication, Mama continued to struggle walking up the hill, but did not while walking on flat surfaces. Two weeks after being introduced to the catch pen, Mama was still showing effort while walking, but had improved. Mama did not return to her original gait, but had reached a new "normal"gait. She received her last dose of pain medication on August 20, 2013 five months after the initial medication course was implemented. Three weeks later, keepers found the remnants of Mama's polyurethane shoes in the catch pen. On September 28, Mama was immobilized a seventh time. An ultrasound was performed and the right rear coronary band appeared healed. The farrier was satisfied with the state of the hooves and Mama was fully medically resolved just over 6 months after the initial injury. The farrier's examination, as well as ultrasound imaging reported that Mama would still have some swelling in her ligaments as well as scar tissue. Her right rear leg would also suffer from 'long term fetlock contracture,' or permanent shortening of the muscles and the joint.

Mama and Tiny remained in their catch pen for an additional four weeks to allow the tendons and ligaments in Mama's leg to strengthen further. Mama continued to walk with a new "normal" gait, one in which she did not plant the bulb of the right rear hoof as close to the ground as the left rear hoof. On October 29, animal care staff felt Mama had mastered the incline of the catch pen and decided she was ready for the 2.5 acres of sandy, hilly pasture where she had previously lived. Mama and Tiny were moved to this area and housed alone for three weeks prior to reintroductions to the herd. (See Figure4) Seven months after their separation, Mama and Tiny were reunited with two of their herd mates. The zebra approached and greeted one another with a minimal amount of kicking and running. Mama's injury did not appear to recur or hinder her in the introduction to the pen or to the other zebra. Four months later, the four animals were loaded into a trailer and transported to a private facility in northern Florida. Mama and her herd mates are currently part of a larger herd and are housed on many acres of grassy pasture. Animal care staff there has reported that she is doing well and her hoof issues have not recurred.

Challenges

Throughout the course of Mama's treatment, keepers were faced with medical, facility and husbandry challenges. Hydrotherapy was an ineffective treatment option for Mama. She would allow the water to spray up on to her feet from the hard surface she was standing on, but would not allow a pressurized stream of water to be applied to her hoof. The goal of hydrotherapy was to reduce inflammation via concentrated water application. Since this was never achieved, hydrotherapy was unsuccessful.

When Mama began exercise therapy in the corridor, the team was faced with several husbandry challenges. The corridor leads to large pens that house multiple different species. The animals housed in these pens, Grevy's zebra in particular, became a distraction to Mama and Tiny as they then shared a fenceline. Keepers would feed the Grevy's away from the shared fenceline in order to encourage them away from this space. The vocalizations from the wattled cranes in the pens initially spooked them, but the zebra quickly became desensitized. The corridor was not covered and therefore storm clouds, rain, and lightning would also cause issues. This was easily dealt with as keepers could adjust the times in which the animals had access to the corridor. Exercise therapy was a learning process for the zebra as well as the keepers, but in the end the obstacles were overcome and Mama's therapy was successful.

The other challenge faced was the wearing down of Mama's hooves from constant housing on a hard surface. The farrier applied shoes to the uninjured hooves in order to relieve pressure and reduce wearing of the feet. Rubber mats were placed throughout the yards in order to provide stable but softer places to stand and walk.

Conclusions

Although lengthy, Mama's recovery was ultimately successful, much due to the diligent teamwork of the veterinarians, keepers, managers, and farrier. Each was willing to go above

and beyond expectations and demonstrated patience and adaptability throughout the entirety of her recovery. Daily observations and communication were critical components of keeping the team focused and moving forward. Keepers recorded her progress in the Daily Report System and kept a separate, husbandry - oriented notebook to aid in determining best practices amongst keeper staff. Disney's Animal Kingdom has abundant resources and professional contacts and in this particular case, veterinary specialists at the University of Florida and a skilled farrier partner were utilized. These networks, however, are not unique to this institution. It is possible for many zoos to collaborate with outside partners in order to provide excellent care for the animals in their collections. Hopefully this paper provides useful information, tools and ideas for navigating through a complex situation such as this, and the potentials and benefits of professional partnerships.

Acknowledgements

We would like to thank Disney's Animal Kingdom veterinarians, especially Dr. Natalie Hall and Dr. Diedre Fontenot who were the point veterinarians on the case, the University of Florida veterinarians that consulted on Mama's case, and the farrier Adam Whitehead. We would also like to thank the West Savannah animal care staff for the excellent husbandry care they provided Mama and for their support while writing this paper. Thank you to Hilarie Weiland for photographically documenting the procedures and contributing photos of Mama's hooves to this paper. Many thanks go to the West Savannah zoological managers: Karen Jasmin, Gary Noble, Jen Windau, Robyn Johnson and Steve Castillo for their support and guidance. And last but not least, we would like to thank Dr. Jill Mellen, Education and Science Director at Disney's Animal Kingdom and her staff for reviewing this paper.

Citations

[1] Extracorporeal Shock Wave Therapy (ESWT) For Horse, *FOCUS-IT Your Specialist for Shockwave Therapy & Innovative Technologies*, http://eswt.net/equine, (June 8, 2015)

Figure 1. Customized pressure relieving shoe adhered to Mama's foot with epoxy.

Figure 2. Synthetic polyurethane shoes for hoof protection.

Figure 3. Mama standing in footbath.

Figure 4. Mama and Tiny in the 2.5 acre holding pen prior to joining their conspecifics.

Golden Ambassadors: Using golden and golden-headed lion tamarins as ambassadors for conservation.

Dr. Jennifer Mickelberg[1] and Kenton Kerns[2]

[1]International GLT Studbook Keeper, GHLT SSP Coordinator, Curator of Primates, Zoo Atlanta, 800 Cherokee Avenue SE, Atlanta, GA 30315, jmickelberg@zooatlanta.org

[2]GHLT Studbook Keeper, Biologist, Small Mammal House, Center for Animal Care Sciences, Smithsonian's National Zoological Park, 3001 Connecticut Ave NW, Washington, D.C. 20008, kernsk@si.edu

Abstract

All four species of lion tamarins (*Leontopithecus*) are endemic to the Atlantic Coastal Forest and classified as endangered. Two of the four species of lion tamarin, golden lion tamarins (*Leontopithecus rosalia*) and golden-headed lion tamarins (*Leontopithecus chrysomelas*), have captive populations in North American institutions as components of their conservation strategies. Over the last 20 years, active conservation programs including reintroduction, translocations, habitat protection and restoration, and education have helped increase and maintain these populations in the wild. Captive populations for both species serve as excellent ambassadors for conservation and can be used to interpret the value of captive populations to the public. This presentation aims to give updates on both the *in situ* and *ex situ* populations for both of these species and provide examples of how these species can be included in zoo collections to promote conservation messaging.

Introduction

There are four species of lion tamarins (Genus: *Leontopithecus*), all of which are endemic to Brazil's Atlantic Coastal Forest and classified as endangered due to habitat loss and fragmentation (Figure 1). Conservation efforts have been in place for all four species at various intensities, and three of the lion tamarins have captive breeding programs identified as a component of the conservation strategy. North American zoos exhibit two of the species: the golden lion tamarin (*Leontopithecus rosalia*; GLT) and the golden-headed lion tamarin (*Leontopithecus chrysomelas*; GHLT).

Golden Lion Tamarins

Captive breeding was identified as a strategy for GLTs in the early 1970s when the population numbers had dropped to as few as 200 due to the pet trade and habitat loss. Found just outside Rio de Janeiro city, only 2% of the forest remains, most of it lost to agriculture and urbanization. In the 1970s, there were fewer than 70 GLTs in captivity, but with improvements in husbandry and management, the GLT population increases rapidly and by the mid-1980s, the captive population had increased substantially and by the 1990s, the population had reached the target size of 500 individuals (Figure 2). The success of this program was a result of dedication and cooperation of zoos all around the world which was coordinated by a management committee. This GLT captive breeding program (the GLT Conservation

Program) became the model for future managed populations, including the Association of Zoos and Aquariums' Species Survival Plans.

With a self-sustaining captive population, reintroduction was deemed a viable option to enhance the wild population. Starting in 1984, zoo-born GLTs were reintroduced into the wild on protected land, protected either by landowners or the government, such as Poço das Antas, the first national biological reserve created in Brazil with the goal of supporting GLTs. Due to limited available habitat and the growth of the reintroduced population, the last reintroduction took place in 2000.

The conservation of GLTs in the wild has also required translocation of GLTs living in small, unsustainable habitat to protected habitats. Several groups of wild GLTs have been moved to the protected biological reserve, União, in efforts to preserve as much genetic diversity as possible. Additionally, forest restoration and education have been key to the improvement of GLT population numbers. Due to this comprehensive approach, the IUCN status of GLTs was changed from "critically endangered" to "endangered" in 2003.

In 2014, a census of GLTs was conducted by staff of the Brazilian non-profit, Associacao Mico Leao Dourado (AMLD) using playbacks—a method for detecting presence of tamarins by playing a vocalization and listening for a response. Our scientists used density estimates from other tamarin habitat and approximated the number of tamarins based on the positive callbacks received. Based on the callbacks, our scientists estimate that there are approximately 3,200 GLTs in the forest.

The goal for GLT conservation has primarily focused on two parts: over 2,000 GLTs with 25,000 hectares (~60,000, acres) of habitat. With this new population estimate, we know that we've hit these two goals. However, in order to really have a long-term viable population for decades to come, we've revised our goals. Although the number of tamarins required for a healthy genetic future remains at 2,000, we know that our 25,000 hectares needs to be both protected (ensuring this land is not lost in the future) and connected (by ensuring forest fragments are navigable by tamarins and gene flow is unhindered).

While the GLT population has increased, there are still significant challenges ahead. Isolation and fragmentation remain the biggest threat to GLTs and this will be even more evident with the widening of the BR101, the major highway that bisects the tamarin forest. This is one of the most traversed roadways in the country and it will be enlarged to a 4-lane highway, causing further damage to the environment while creating a larger obstacle for tamarins to cross. We are currently researching options for a bridge-like structure that would allow wildlife to cross over the traffic.

Introductions of non-native invasive species that compete for GLT species continues to be a concern. The common marmoset, most likely introduced to the GLTs' section of the Atlantic Coastal Forest by pet owners abandoning their animals, may compete for food and nesting resources with GLTs. There is also the possibility of disease transmission by common marmosets for which GLTs have no natural immunity.

The success of the GLT program relies on a One Plan Approach combining both *ex situ* and *in situ* efforts. Continued success will rely on the continued support and cooperation of both components. Zoos have played a critical role in GLT conservation and have an important role to play to secure their investments.

As zoos strive for more and more links to conservation of the species they hold, the GLT program provides an excellent example of how zoos contribute to conservation and how, when working collaboratively, we can make a difference.

Golden-Headed Lion Tamarins

The golden-headed lion tamarin (*Leontopithecus chrysomelas*; GHLT) is found in the eastern Brazilian state of Bahia. GHLT habitat was lost to cattle ranching and cocoa farms. Farmers in the region use the *cabruca* system, which allows cacao plants to grow underneath a canopy of mature native plants. GHLTs are able to use the crops and mature plants growing on these farms to travel, allowing fragmented groups to interbreed. As other crops emerge as more lucrative for farmers, the *cabruca* system may be lost, furthering the loss of GHLT habitat.

The Una Biological Reserve was created in Bahia in 1980 for GHLT conservation and houses a current population of around 500 individuals. Captive breeding groups appeared in the mid-1980's, after an increase in illegal export of GHLTs from Brazil. In 1985 Brazilian authorities created a group to manage GHLTs which succeeded in returning some of these animals to Brazil and others to zoos around the world for captive breeding. Most GHLTs, like GLTs, are owned by Brazil and are on loan to the zoos that exhibit them. GHLTs were often kept as pets, and many of the founder animals in captivity are confiscated or surrendered. GHLTs experienced a population boom in captivity due to the application of knowledge of husbandry and reproductive care detailed for GLTs (Figure 3). Although the captive population of GHLTs has not been reintroduced to their native homes, the captive population holds the important role as a genetic reservoir for their wild cousins.

GHLTs, much like the common marmosets, were abandoned by pet owners in a park just outside Rio de Janeiro (within the GLT historic range). Fed by the local community, this population of GHLTs increased and has been getting closer to GLT occupied habitat, much further south than their historical range in Bahia. Fearing contact with GLTs which could lead to hybridization and possible disease transmission, scientists mobilized and began trapping GHLTs from this park. Some GHLTs have been rereleased into their native range while others have been transferred to zoos.

GHLTs are listed as endangered. There is an estimated 6,000 to 15,000 wild GHLTs in Bahia. The population suffers from serious forest fragmentation. There are 100 GHLTs in 20 US zoos, with a total of ~570 animals in 105 institutions worldwide.

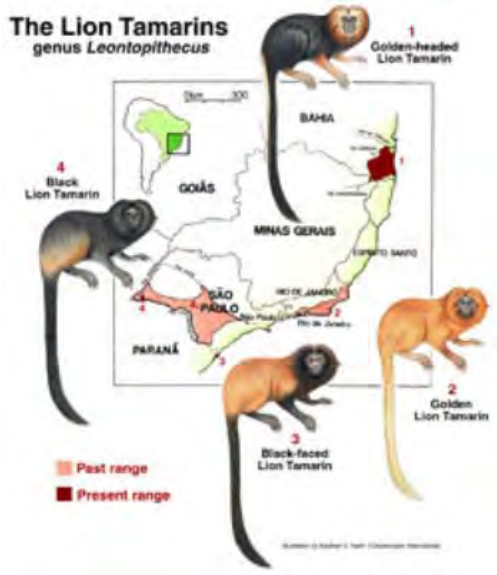


Figure 1: The four lion tamarin species. The black lion tamarin is listed as endangered, with a population estimated to be less than 1000 individuals. The black-faced lion tamarin is listed as critically endangered, with a population estimated to be less than 400 individuals.

Source: Stephen Nash, Conservation International

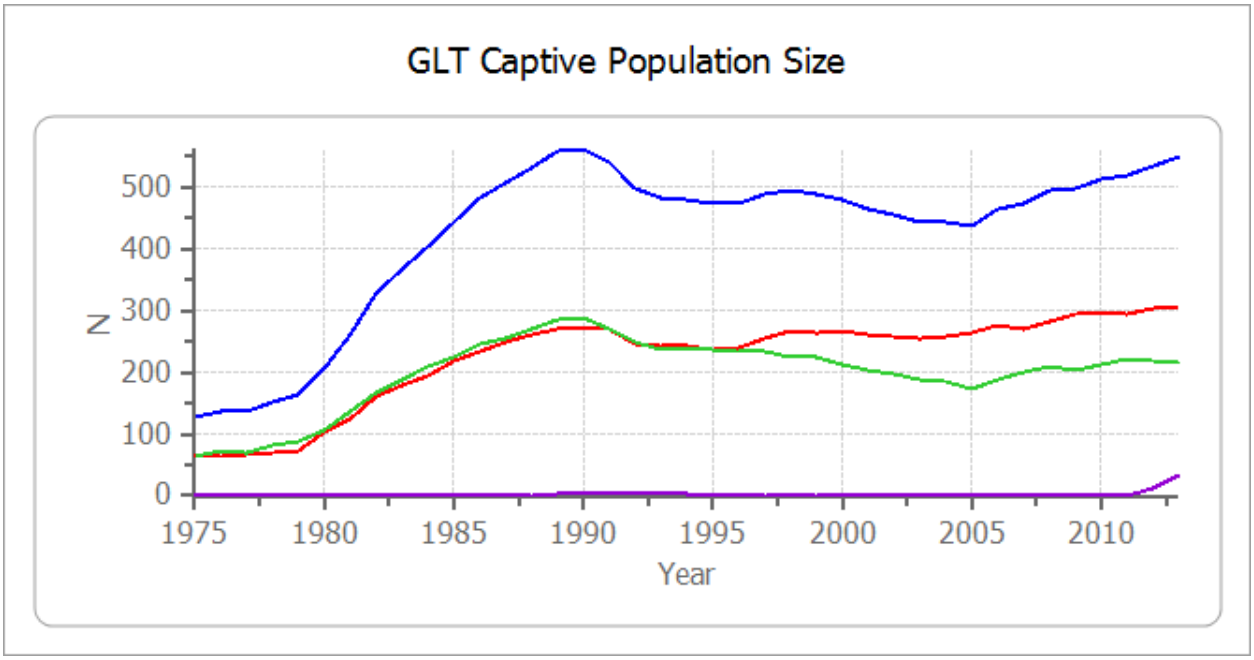


Figure 2: Captive GLT population growth. After a rapid increase in the population in the 1980s, the population has been maintain around 500 since the 1990s. . Legend: blue = total, red = males, green = females, purple = unknown sex.

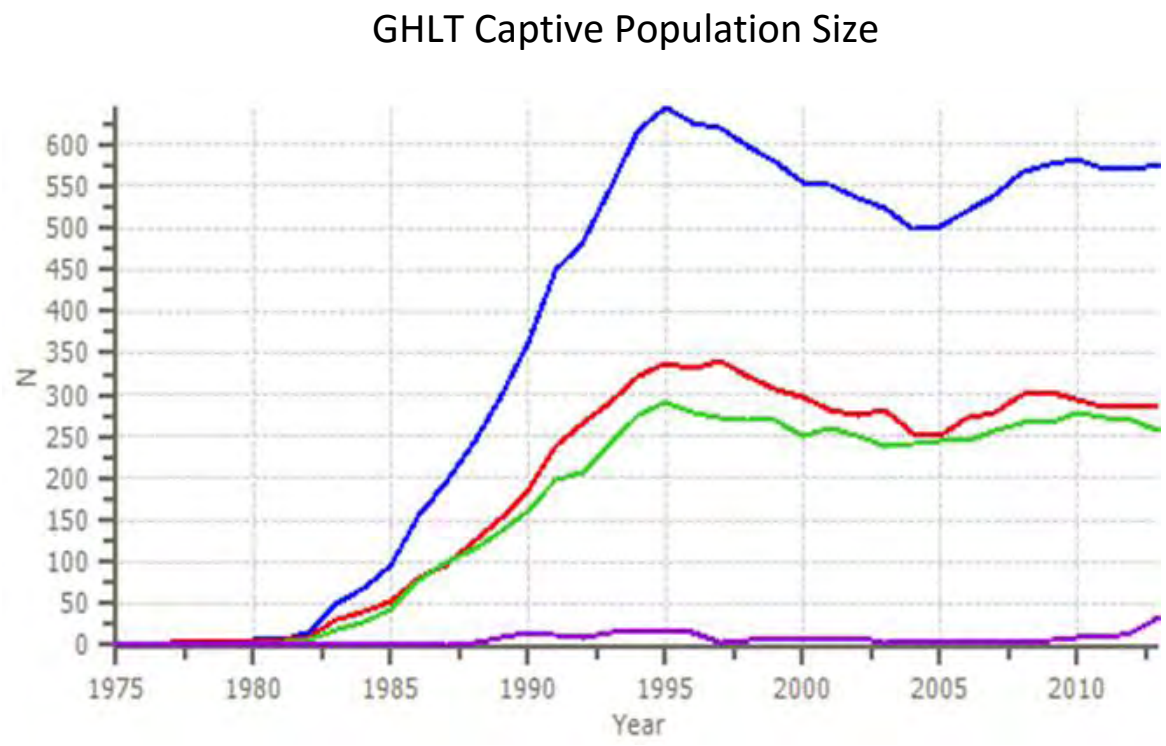


Figure 3: Captive GHLT population growth. Legend: blue = total, red = males, green = females, purple = unknown sex.

Conservation Ambassadors

Lion tamarins in zoos as conservation ambassadors allows us to discuss a number of important issue facing endangered animals and highlight the successes possible with an efficient and well-planned program. Items that can be highlighted during discussions involving lion tamarins:

- Successful collaboration between zoos for cooperative breeding for genetic diversity.
- Successful reintroduction program into native habitat.
- Ability of zoos to contribute to on-the-ground conservation in the wild.
- Knowledge of zoo animal behavior contributed to our understanding of these animals in the wild.
- Partnership between *in situ* and *ex situ* programs contributed to the success of this species.
- The important of lion tamarins as a flagship species for the Atlantic Coastal Forest, saving countless other species.
- Effects of the pet trade on a small primate species.
- GLT upgrade from critically endangered to endangered—a sign of success!
- Importance of continued monitoring of a species, including population and habitat.
- Importance of working with local business owners near endangered habitats to ensure sustainable yet economical businesses receive support.

Tracking Tamarins

Save the Golden Lion Tamarin, the US non-profit that supports AMLD in Brazil, is working to fundraise for radio telemetry supplies needed to track tamarins in the wild. In order to locate and follow tamarins in their dense Atlantic Forest habitat, AMLD biologists affix radio collars to one or two adults in a monitored family group. AMLD uses a telemetry receiver and antenna to locate the collar's unique "beep." Once located, the team follows group and monitors their location behavior and any threats. A GLT family group can occupy 124 acres of Atlantic Coastal Forest, so radio telemetry is imperative for locating the animals. Staff in Brazil have been using radio collars to track tamarins for over 30 years for a number of reasons:

- **Monitor the health and size of the wild tamarin population.** Individuals in each group are identified, and a detailed account of births, deaths, and range of the group are logged, showcasing long-term pedigrees of GLT family groups.
- **Manage the wild tamarin population.** Translocated groups that were moved from threatened habitats to viable sites are tracked to study their acclimation to their new home, and staff is able to intervene if needed.
- **Detect threats to golden lion tamarins and their forest.** Staff members tracking tamarins are the first to know if a tamarin has been trapped or if their habitat has been encroached upon by fire or deforestation. Such issues are promptly reported to the Brazilian authorities.
- **Locate animals for ecotourism groups.** A few groups of tamarins have been released on privately owned forest, and ecotourists are invited to visit GLTs in the wild. In order to find them quickly and safely, staff members track the groups' radio collar signals.

In 2015 SGLT announced a new program, Track-A-Tamarin, with a goal to raise $10,000 by December 31st each year that can be sent directly to Brazil to support the continued tracking and monitoring of the wild GLT population. SGLT is challenging individuals and groups to think of creative ways to fundraise for GLTs and the Track-A-Tamarin campaign.

Further Reading

Kleiman, D. G. and Rylands, A. B. (eds). 2002. Lion Tamarins: Biology and Conservation. Smithsonian Institution Press, Washington, DC, USA.

Save the Golden Lion Tamarin at www.savetheliontamarin.org , the US non-profit that fundraises and supports AMLD in Brazil.

Strategies for Navigating the Career Transition from Keeper to Animal Manager

By Dennis Charlton, Animal Keeper
Smithsonian National Zoo
Washington, D.C.

Animal keepers, aquarists, and trainers who have had dreams of one day becoming managers in their respective fields often find themselves in the awkward position of supervising their peers with that first management position. This change from working with primarily animals all day to handling a potentially large and diverse team can be extremely abrupt and stress-inducing. In addition to supervising department staff, first-time managers must learn to balance the demands of working with an extended zoo team that includes other curators, senior-level managers and directors, veterinary staff, facilities, exhibits, and many more. Navigating the transition into animal management can ensnare many new supervisors with social pitfalls, a sense of isolation, absence of peer support, and general lack of team cohesion. These negative outcomes can be extremely demoralizing and lead to poor job performance and reduced potential for optimum animal husbandry within the department.

Fortunately, there is an arsenal of simple communication and management tools that newly minted animal managers have at their disposal to help avoid the majority of these transitional job hazards. Animal keepers, trainers, and aquarists who take their time in goal planning and communicating both prior to and immediately following their promotion to management can maximize their accomplishments and reduce stress toward becoming successful managers at their respective institutions.

Animal staff can actually begin preparing for a transition into management months or years prior to ever applying for an available position within their own or another organization. Depending on the departmental structure within the zoo or aquarium, there are usually a myriad of opportunities to get involved with work outside of the daily job details that may allow a keeper a better understanding of the road ahead as a manager. For instance, while many animal departments are often sub-divided by taxa and specialties, institutions will generally offer cross-training potential and staff can benefit by learning how to work with keepers from a wider variety of backgrounds and experiences. Even within their own department, an aquarist wanting to advance should try to tackle more group projects outside of their comfort zone including exhibit design, product inventory and ordering, and protocol development. These activities may bring staff more involved with the facilities portion of the zoo and offer experience in communicating with departments including maintenance, graphics, and supply – vital practice for the road

ahead. Taking initiative in training and directing department volunteers and interns can also be a huge benefit in practicing management techniques in a supervisory role.

Immediately prior to beginning that first animal curator position and even during the application process, the employee should be prepared for the social dynamics within the work environment to change slightly if not dramatically. While some co-workers will be entirely genuine in their support for the career move, others may be more skeptical about your motivations and qualifications for being a manager. It may be necessary to focus on the positive individuals at first but it is also very important to engage the rest of the team in constructive dialogue. An effective manager will not alienate any member of the team and be wholly inclusive as co-workers can be very sensitive to favoritism during this transitional period. Some options for building trust with your peers at this time may involve offering them a hand with projects or training sessions, posing inquiries about department issues or concerns they may have, or even just taking the time to learn more about their career experiences.

The first day following a promotion into animal management can be extremely exciting and stressful all at once. There are ways to incorporate certain business styles of management into the new position in order to be an effective leader but these techniques would need to be tailored to an animal supervisor. One such leadership style involves utilizing six fundamental principles for being a successful manager (Watkins 2009.) They are the following: organize to learn, define strategic intent, establish A-item priorities, build a leadership team, secure early wins, and create a supporting alliance. Starting from the beginning, new animal managers will have quite a bit to learn about their job duties but also about the department and staff as a whole. Managers should be curious to explore every aspect of their new position and talk to employees, curatorial peers, and supervisors to determine priorities for the coming weeks and months. This will help in defining strategic intent or a manager's vision of what they would like to achieve, which may be as simple as improving intra-departmental communication or as extensive as re-organizing unit duties and exhibits. Establishing top priorities is a must in those first few weeks as it gives managers something to strive for. An animal curator may see a huge need for new uniforms or computers to improve morale or a failing animal exhibit needs attention. Regardless of the issue, they should look toward getting several A-list items completed in the first year ahead. While immediately building a new team may not be entirely applicable in the zoo and aquarium setting, new managers can certainly help building "up" their current team in various ways. Recognizing employee strengths and accomplishments goes a long way to building staff support as well as fostering team cohesion. Managers can go for the easy wins as well in these early days in their lead roles to help prompt further change. This could involve getting work tickets pushed through the system, new animal enrichment approved, or organizing teams to knock out a group project. Finally, new supervisors will want to create supporting alliances by finding those who they can trust to support their initiatives and goals, including other managers.

In the overall picture of transitioning into animal management, there is likely nothing more difficult than trying to define a role with the people who are former co-workers of whom many may be counted friends. New managers will need to get to know the animal keepers and trainers all over again but from a different perspective and the key to being successful in this is to listen. Employees of any kind in any job description simply want to be listened to – their ideas, no matter how quirky or outlandish they may seem on the outset, are entirely relevant to them and trust can be earned quickly by giving them that time to share. Along with opening lines of communication, managers can continue to build trust by being open and honest about knowledge or lack thereof. They should avoid trying to boast of their accomplishments and instead try to focus on the strengths and talents of their staff. For example, an avian manager may have a team that is working toward training a ground hornbill for demos and it may be beneficial to bring in that senior bird keeper with years of hornbill experience to help lead the training plan. Managers can begin to build a true team environment where staff respect them and recognize what they are trying to accomplish.

Supervising friends can be incredibly challenging and many of these friendships will likely change to some degree. New supervisors should take some time to speak with their friends about re-defining roles and separating the friendship from work. This may involve a mutual understanding of certain boundaries that should be maintained to avoid favoritism and hurt feelings. Even so, managers should expect some degree of tension or teasing by those they consider close friends and act professionally in addressing the situations. They should strive for being fair, discreet, sensitive, open, and friendly with all employees,

Working with other zoo or aquarium managers may present another unique set of challenges for an inexperienced curator or supervisor. Seasoned or high-level managers as well as other departmental supervisors will have their own agenda or unit goals to meet which may conflict with the animal department at various times. Animal managers should take the time to understand the job duties of their new peers and be respectful of their department initiatives. It takes time to be accepted by curatorial peers but with a bit of confidence in their role and a passion for growth, a new manager should be able to transition smoothly into the team. They should also look to their own supervisor for help in establishing expectations for the position and take those initial first steps in laying out what they hope to achieve in that new role. A good tip might be to establish a goals plan for the next six months.

In conclusion, transitioning from the direct daily animal care into an animal manager at a zoo or aquarium can be emotionally stressful and difficult to manage for many people. While there are certain established methods for managers in any career to be successful in their new positions, these techniques must be tailored to meet the needs of the animal husbandry professional. Newly established managers will need to focus on fostering trust and respect from their team, developing clear departmental goals and initiatives for their first year, and learning to work

effectively with managers from all backgrounds. Utilizing these techniques and taking time to grow into the position can go a long way in helping staff members develop into successful managers at their respective institutions.

Bibliography

Bakken, Elizabeth, B.A. M.A. “Making the Transition to Management.” 2001, Ceridien Corporation.

Institute for Human Services (Ohio). “Strategies for Transitioning into Supervision.” Jun 2015, Ohio Child Welfare Training Program.

Watkins, Michael. “Picking the Right Transition Strategy.” Jan 2009, Harvard Business Review.

A Keeper's View on Managing the Federally Endangered American Burying Beetle *Nicrophorus americanus*

By

Daniel Koch, Invertebrate Keeper

Saint Louis Zoo

Saint Louis, Missouri

Abstract: I volunteered to become the Point Person for the amazing invertebrate the American Burying Beetle (ABB) in 2004 when we received our first beetles. I learned of this beetle just a year earlier after I was hired as a keeper at the Saint Louis Zoo's Monsanto Insectarium. The staff was surveying Missouri looking for remnant populations. This is the animal that was chosen as the focus of the Invertebrate Department for the Saint Louis Zoo's Wild Care Institute that was established in 2004. Thus the Center for American Burying Beetle Conservation was created.

Right away, I read over the husbandry protocols from other zoos and universities. I immediately, saw ways in which we could improve on the husbandry, population management, data collecting and ultimately reintroduction of this species. Along with the Insectarium staff, and the support and encouragement of my Zoological Manager and Curator, we have maintained the longest continuous breeding population of ABB. Because of the scope of our project we have created and developed the protocols for husbandry; breeding and record keeping that are now used by various institutions. We have collected data on the biology, husbandry, and conservation of the ABB that have been invaluable. We have reintroduced this species back to the wild and are having visible success in Missouri. The Saint Louis Zoo has become one of the primary clearing houses of information regarding this beetle. Make no mistake, it is a team effort, across various institutions and organizations, and I am proud to be one of the key people that are making the difference in the conservation of this amazing animal.

Natural History-- American Burying Beetles are in the Carrion beetle family Silphidae and the largest of the *Nicrophorus* beetles in North America. There being a total of 15 species in the genus, but only this species is endangered and in trouble. They can be up to 35 mm in length and can weigh over 2 grams. They are also the only ones that have an orange macula on their pronotum. The American Burying Beetle was found throughout 35 states east of the Rockies and 2 provinces of southern Canada but is now only found in 6 states where they are in isolated populations. They are found in Rhode Island, Nebraska, Oklahoma, South Dakota, Kansas, and Arkansas. They were put on the Federally Endangered Species list in 1989. There are also ongoing attempts to reintroduce the beetle in Ohio and in Missouri. The reason for the decline of the American Burring Beetle is unknown but may be due to habitat loss and alterations, competition for reproduction resources, pesticides, unknown diseases, nighttime lighting and bug zappers. (Amaral,M.,Kozol and T. French) Since they are the largest of the *Nicrophorus* species they will require the largest carrion resources - with anything from a bird, rodent, mammal, reptile, or fish being a useful source as long as it is the proper weight.

Lifecycle-- They live about a year in the wild. They become active at night when the night temperatures reach above 60 degrees Fahrenheit. They will fly to find appropriate size carrion source which they can smell shortly after death from up to 3.2 km (2 miles) away. They will battle their own species and other carrion beetles to claim the carcass. The winning pair will then hurry to bury the carcass so other

scavenges or larger animals like opossums, raccoons, coyotes, and foxes do not get it. Sometimes, the pair will move it to a better site by lying on their backs and passing it over to each other with their legs. They bury the carcass and remove the larger bones, scales, feathers, and so on. This process of burying a carcass would be like two humans burying a minivan in a night just using their hands. It is an amazing site when they bury a carcass by just removing the soil under the carcass, and it slowly disappears into the ground. They then work it into a ball, embalming it as they go with oral and anal secretions. The pair works to form a cell around the carrion ball to raise their young, laying eggs near or on the meat ball. When the eggs hatch, both parents will chew and regurgitate the carrion to their young. They will continue feeding them until they are old enough to feed on the meat ball themselves. It is very unusual in the invertebrate world for both parents to help raise their offspring which includes feeding their young. At around the 10 day mark when the larvae are at their 3rd and last instar, the male will leave the female and larvae. The female stays for few more days protecting her offspring and excavating areas for the larvae to pupate in. She leaves the larvae which then pupate and emerge as new beetles all by themselves. They take 45 to 60 days to emerge as adults. They are sexually mature at 21 days old and cycle begins all over again.

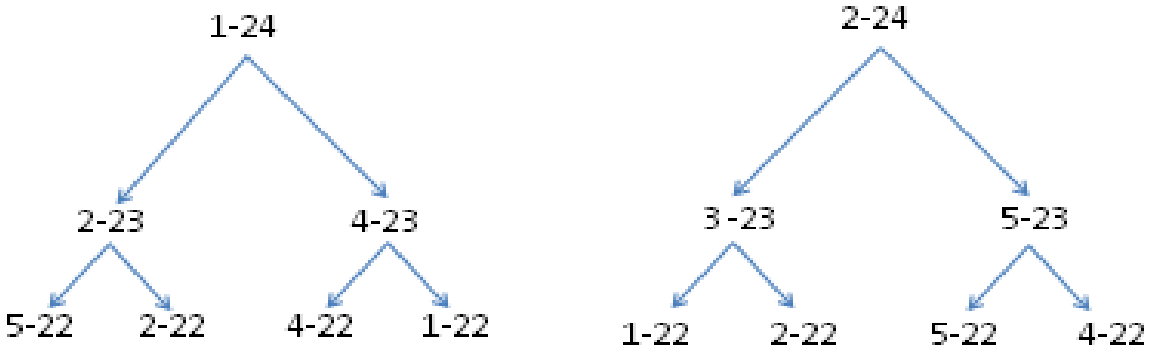
My Involvement--. First off, I am amazed that I am working to such an extent with a federally endangered species. When the point person for the species was being decided, I was a new keeper. Tradition dictated that senior keepers get the first option to choose what animal they are in charge of. I knew that I wanted to be involved with this species, even if I was a secondary, under another point person. The Saint Louis Zoo's Invertebrate Unit was already surveying in Missouri for 1 season in 2003, and was working on obtaining wild beetles to start a colony. So when we got in our first ABBs in fall of 2004. I assumed that someone else would be in charge of their care. As it was, however, I was at that time, raising a common species of burying beetle, *Nicrophorus marginatus* to gain more experience with the genus. I had good success with them and gained a lot of insight that would help with the American Burying Beetle. On a side note, I would recommend anyone thinking of raising ABBs, or any animal that is endangered or difficult to raise, to learn and make your mistakes on a similar common species. So in the fall of 2004 I became the first lead or point person for ABBs at the Insectarium. I had read over various care and breeding protocols from other universities and zoos prior to receiving the endangered beetles. .

Population Management--Rearing methods documented by some other institutions were oftentimes based on breeding from one generation to the next, and selection was, more often than not, based on brood relationship as opposed to individual beetles. It was also uncommon to find records prior to a generation for breeding selection. After surveying the various methods that had been tried and some internal discussion we plotted a course for our colony. The things we wanted to do would take more time and labor, but, as a team, we agreed that if we are going to do this, we needed a specific protocol that met our standards.

Firstly, I pushed for and we decided to house every beetle individually with an individual, permanent I.D. number. A record keeping system was set up to track a number of things about that beetle. This would allow us to track every individual throughout every aspect of their lives. It would give us precise data on times for emergence, lifespan, kinship, weights, and biometric measurements. Initially, we kept all our records on paper because existing animal record keeping programs did not capture the specific information that we felt we needed to track. We addressed that, with the help of a Zoo volunteer, who devised a species specific Access database program. As years went by and Access was no longer supported by Microsoft, an insectarium keeper, Glenn Frei converted our database to Excel format. This has provided more options and an easier entry interface. Experiences with past iterations of record keeping have helped us to continually improve upon various aspects of record keeping. Now with the data, we can trace everything from successes and failures, tracking trends that improve on our husbandry and ultimately, care for beetles.

Next was considering the genetic management of the beetles. I love working with genetics and this was the one aspect that we felt we would manage strictly. We opted to make our breeding choices that were no closer than 2nd cousin level. And while not completely necessary for this, the database program made it much easier to know the percentage of relationship between choices.

Example:



Looking at the above diagram, you might see how closer relationships than second cousin could present some problems with pairing choices. The grandparents were brother and sister. These two beetles 1-24 and 2-24 are actually a 64% relationship to each other. So, in subsequent pairing of offspring if we were to only go to 1st cousin level they show no relationship at all. However, if this is done numerous times, this inbreeding could potentially cause many problems from defects in beetles, problems breeding, and ultimately the colony dying out. This is why we chose to go to 2nd cousins, or further, with all our pairing choices with only a few pairing with 1 of grandparents being related, out of necessity.
We started our colony with four wild caught beetles in the fall of 2005. Our approach was to out-cross until we bred out the relationship the best we could. From these original four beetles we produced 18 generations. This is when we started having breeding problems. Then in July of 2010, we got fresh stock of six pairs. We have not had any problems since.

We still have the original blood line in our colony as the offspring of our original four beetles bred with the fresh stock. Just not with each other in the original colony. We still occasionally get fresh beetles, when available to keep our colony strong. One or two pairs of wild beetles make a large difference in improving the genetics of the colony. Because we are tracking individuals, we are able to see trends with certain lines failing to reproduce. We are also able to track how many attempts an individual is offered for breeding. This helps with choosing parings that have the best chance for success in continuing a specific line. Individual records allow us to see if a beetle may be sterile, has difficultly breeding, or even be just a bad parent- like eating their young. We can track the complete family tree for each beetle. We can tell you how many times each beetle was bred, the number of offspring produced - with whom, and how long they lived. We can also make sure that every line gets equal genetic representation in our colony.

Protocol-- We have streamlined and firmed up our breeding and care protocol over years. I feel this is why we have seen the improvements in production of beetles with fewer deformities and less death of larvae. The beetles are living longer. We are continually looking to improve on these protocols. Our goal is that each change contributes to health and wellbeing of the beetles. Personally, when I see the little thing that can make difference, I use it.

For instance, I saw the potential to improve breeding protocols by collecting data that I felt could improve the care of the beetles. I started tracking successes on different carrion sources. We tried chicken, rat, and quail. These comparisons ultimately showed no difference in production of offspring. We only use quail now. The quail are easy to get and are cheaper than using the other sources. But we now have all those breeding with different carrion sources on record in case we'd like to refer to it in the future.

The husbandry protocols for the ABB are little more detailed in order to collect as much data as possible - to document more about the biology and life cycles of this beetle. This was done with the intent of improving the health and care of this beetle in the lab, with the ultimate goal of maximizing our efforts for reintroduction of the beetle back into the wild.

All the beetles are kept in a small temperature controlled room. The room is maintained at all time in between 20-24C (68 to 75 degrees Fahrenheit) year round. The sweet spot is around 20.5 or 21 C (69 or 70 degrees Fahrenheit). If temperature gets to high it could potentially cause stress to the beetles. They do not live as long and do not breed as well at higher temperatures There is even antidotal evidence that can even be sterilized if gets to warm.. I have observed behaviors that seem to indicate if they are even getting warm or to cool. They seem more restless when it is too warm and are less active when it is too cool. Additionally, while in their breeding buckets, if the pair of beetles buries to a shallow level, it is too cool in the room. If they bury real deep, then it is too warm in the room. So I adjust the temperature to fit the needs of the paired beetles. This behavior is sometimes seen even if the temperature remains the same. For instance, in summer I often have to run the room cooler and in the winter the temperature required can be a bit warmer.

The lights are turned on during the day when we get to Insectarium in the morning and turned off when we leave in the evening. The room is not on timer. We have not seen any increase in breeding success if we increase light hours when breeding or getting ready to breed. We have good success and less hassle when we manage the light cycle like that.

We keep each beetle in individual containers 7.62 X 19.05 X 10.16 cm (3 X 7.5 X 4 in.). Each container has an individual, permanent ID label on them. The ID label has the individual's number, gender, bucket number, generation number, date of emergence, parents' ID numbers and bucket and generation numbers of that individual's parents. All information on the I.D. card has corresponding records in our Excel computer program.

The beetles are separated into groups to divvy up feeding rotation. Each group is feed twice a week. While feeding, we strip and clean the container each time. The container will get one paper towel for the bottom of container and another one is just crumpled up on top of the other towel. The towels are well dampened for moisture for the beetles to drink and to maintain humidity. We then add four wax worms and four mealworms to each container for food. The beetle is then put back into the container and the lid is secured with a rubber band. Being very strong, the beetles can escape if the lids are not secured in this way. The twice weekly feeding is a good opportunity to monitor each beetle.

Each beetle's whole life cycle is recorded from egg until death. Our records capture weight in grams at emergence, breeding, and after breeding. We also measure each beetle's pronotum at the widest width, in millimeters. We keep records on all of their breeding success and failures. We know who each beetle was paired with, as well as how many offspring they produced. Lastly, we record date of death and pin each beetle or put degraded specimens in alcohol. The only exceptions are the rare times that a beetle died in bucket and rotted away. We label these in our records as Missing In Action or MIA.

Reproduction-- With the freedom granted me over the years, I have tried my best to streamline and improve on the reproductive methodology. With the intention of improving conditions and overall success for this species, I have tweaked and adapted the process. The Saint Louis Zoo waits until the beetle is 21 days post enclosure to breed them. We refer to this as when they reach "sexual maturity." However, we rarely breed them when they are as young as 21 days, opting to wait a little longer. We now have two breedings (or generations) a year, down from three. We found that we were producing too many beetles throughout the year that were not being used for our reintroduction effort. They were, in effect, just living out their lives, sitting on a shelf. This also created more labor in feeding and caring for these additional beetles. Breeding begins in August and then again around the end of January.

The January breeding is specifically geared for our June reintroductions. The August breeding is primarily to maintain the colony into January. This is instead of having as many as three and half generations a year. Cutting back to two breeding a year allows us to focus on the June reintroduction. Also, instead of having 300- 400 beetles to care for, we have only 100 to 130 on shelf. With the twice annual breeding, there may be some selection for longevity. In theory, the more short-lived beetles might not get a chance to breed in this system. Our record system will allow us to test this theory in the long run by analyzing trends in lifespan over multiple generations.

As mentioned above, the beetles are paired up with the opposite sex that is no closer than second cousins A breeding card is filled out that has individual numbers, generation/bucket numbers for the pairing, date of paring and weight of the carrion. The bucket is also given a "pairing number."

We have found that the ideal weight for the carrion resource that we provide, should be between 120 to 160 grams. However, higher and lower weights will still produce larvae. Lower weights will produce fewer larvae and larger weights can create challenges for the pair to burying the carrion. We have given some of our larger beetles a heavier resource and they have no problem burying the carrion. The largest carrion source used was180 grams, which the pair buried with no problem, but they did not produce any more than normal amount of offspring.

The pair is the placed into a five-gallon bucket that has over 100 holes, of 4.76 mm (3/16 of in.) diameter, drilled in the bottom. We then put a metal window screen over the holes at the bottom. The screen needs to be replaced when damage is noted. Next, soil is added to the bucket about ¾ of the way to top. The soil is a mixture of topsoil, sand, and potting soil, which has a lot of peat moss in it. The soil mix that we use is about ½ topsoil, ¼ sand, and ¼ potting soil. The soil is soaked with hot water until it runs out the bottom of the bucket and then left to drain and settle for at least three days. I usually set them up a week ahead. If we are reusing a bucket, the soil is frozen for 1 or 2 days and then thawed. Fresh soil is added if needed before being soaked. The soil is not reused when it is either judged to be too full of bones and feathers or when it is about a year old. When the pair is added, the bucket lid will be put on tightly so the beetles cannot escape.

The lid has the center cut out and window screening is siliconed over the hole for light and ventilation. This also allows us to see the progress of the burial of the carrion. The pair is weighed and placed into the bucket. The pair is then watched to ascertain if they bury the carrion. If the pair does not bury the carrion within three days they are removed. The male and female are weighed again and marked as unsuccessful in their records. The removed beetles could be reused or tried again after a five day waiting period. This is always with a different mate if possible.

If the pair does bury the carrion, it is recorded both on the card and in the records. The bucket is then checked 10 days after burial for larvae. This is done, very gently and methodically, by digging through the soil until the brood chamber is located. If no larvae are found, the pair is removed and weighed. This is noted, both on the card and in their records as unsuccessful. The old carrion is removed and bucket is

frozen. Again, we wait at least five days before they could be used again. And, again a different mate is chosen if possible.

If the pair produces larvae, it is noted in the records and on the card. At this point, the bucket is given a specific "Bucket /Brood number." This is the number that every beetle produced from that bucket will have. This how we trace their relatedness; it is like a last name.

The male can be removed at this time if he is found. If he is not found by the time the larvae start to migrate, the bucket is stripped clean to find him. Our concern is that the male could eat his offspring with dwindling carrion resources remaining. Also we may be able to use him again for breeding. We also do not want to mistake him for one of his offspring at a later date. The female at this time is left with the brood until the larvae start to migrate a few days later. She is then removed for the same reasons given for the male. She is left with her brood during the interval, however, because she helps to create tunnels for the larvae to migrate and pupate in. When larvae are discovered, the bucket lid is covered with black plastic to keep the light out. The black cover is left on until the larvae migrate away. Blocking the light prevents the parents from reburying the carcass. This allows easy observation of the brood during development, without having to re-excavate each time they are checked.

With a little experience it soon becomes apparent when it is time to remove the parents. The male is observed on top of the soil instead of underneath. In the wild this is when he would leave the chamber and possibly pair up with new mate. Interestingly, he is also covered in the beneficial, phoretic mites at this time. The mites pick up on some cue that he is about the leave and then they climb on the male for a ride to next carrion source. A few days later, the female will also prepare to leave the brood. She too, will be covered in beneficial, phoretic mites. If you watch carefully you will not have to disturb the larvae at all. Minimal disturbance of the larvae has the advantage of less stress for them and less chance of damaging any of them during your hunt for their parents. When the larvae migrate, we put back into the bucket the soil that was removed and frozen earlier in the process. The lid cover, added for darkness can now be removed for ventilation. This allows us to able to see when the new beetles start to emerge.

When the parents are removed they are both weighed and this is recorded into their individual records. In the wild, the male usually leaves around day 10, but the female stays with the brood until about day 12 to 15, when the larvae start to migrate. However, in the lab, we have seen the larvae take up to 20 days to migrate. We speculate that this time difference has to do with the amount of carrion; they migrate when they run out of food.

The migrated beetles pupate a day or two later. The successful pair is marked in their records and can be rebreed after 14 days to a different mate if it is decided to use them again. The bucket is then marked with potential future emergence dates of the larvae. This is 45 to 60 days after burial of carrion. Between 45-60 days post burial, we will remove any beetle and note this on the card and their individual records. On the 60th day, we go through the bucket and record any un-emerged beetles found in soil - dead or alive. Typically we find nothing or few left in soil.. The bucket is then frozen and we then follow the protocol for the buckets.

These are our protocols, in simple form, that we use as a reference for what to do at each step:

ABB Individual Beetle Protocol

Age	**Protocol**
Freshly Emerged	Assign each individual a number, note gender, log in breeding book, weigh and measure and enter info into computer. Retire if deformed or under 1 gram. Print tags. Retired ones are marked by the computer to show they are retired. Wait 21 days before breeding.

Adult/Male Unsuccessful Breeding	Log into computer the weight and that it was unsuccessful. Can rebreed to different female after 5 days. Make sure no closer than 2nd cousins.
Successful Breeding	Log into Computer the weight and that it was successful. Can rebreed to different female after 14 days. Make sure no closer than 2nd cousins.
Adult/Female Unsuccessful Breeding	Log into computer the weight and that it was unsuccessful. Can rebreed to different male after 5 days. Make sure no closer than 2nd cousins.
Successful Breeding	Log into computer the weight and that it was successful. Can rebreed to different male after 14 days. Make sure no closer than 2nd cousins.

ABB Bucket Protocol

Timeline	**Protocol**
Intro of male and female	Fill out Breeding Bucket Sheet. Weigh the male and female before placing them into the buckets. Log into computer. Make sure that the carrion source is between 120 and 160 grams for ideal conditions for the pair. Place the pair into the ¾ full buckets that has been soaked 3 days ahead of intro of the pair and secure the lid.
1 to 3 days after intro	Check daily if the carrion has been buried. When carrion has been buried, mark it down on the card and log into the computer. Make sure you put down the "to-check-dates" (10 days after burial). If the carrion is not buried by the 3rd day remove the male and female, weigh them both, and record on card and computer as unsuccessful. Follow protocol on individual sheet.
10 days	Gently dig though the soil to find the brood chamber. If no larvae are found then remove both parents and weigh them following the Individual beetle protocol. Record all data on card and in computer. If larvae are found, count them best you can without disturbing them too much. Mark on card and follow protocol for each parent. Do not rebury meat ball so we can observe development to gauge when parents should be removed. Freeze any soil that was removed for a day. Cover the bucket lid or use solid lid to block out light, so the beetles do not rebury the brood. Lastly, put down the emergence dates 45 through 60 days after burial on card.
Male	Remove if found. Weigh him. Mark on card and log into computer. He usually is at top or ready to leave at day 10. He must be taken out when larvae start to wander. If he is with the larvae and you do not see female - do not remove. Female may have died and he is raising them.
Female	Leave in bucket until larvae start to wander. She helps create tunnels for the larvae, so they can pupate. When she is removed, weigh and record on card and in the computer.
Wandering of the	This is usually at 12 to 15 days after burial. Take out both parents if not out already. Otherwise the parents could eat their young. After the larvae leave

larvae	the brood chamber the regular screened lid can be put back on for better ventilation. Remove any leftover carrion and add the soil back to the bucket that you had removed- to fill in brood chamber. The bucket should be as full as when it was started.
45 to 60 days	Watch for the larva to emerge from the soil. This usually happens 45 to 60 days after burial of carrion. For ones that do emerge, follow protocol for freshly emerged ABB. Break down on the 60th day to see if any other beetles left or if there are any un-emerged ones. This info is all recorded into the computer.

Then of course, the date of death is recorded in the computer program. The beetle has a pinning label made, and the beetle is pinned or put in alcohol. The specimens are kept for a running inventory or potential genetic research.

I have had great success with these guidelines but I am always trying to improve the protocols. Our openness to new ideas and methods is again evident from the fact that right now, we are comparing two methods of mate selection, to see what might be better for the beetles. This was just started this January.

For the first method, we have the computer pick the individuals for breeding for what we call "the blue line." This appellation is based on the color of buckets used for these pairings. There are no exceptions and no beetle is left out from potential selection. A randomizer on the computer will choose a beetle based simply on relatedness, no biometrics are considered. Genetically speaking, any beetle can carry traits that could be beneficial to various random and unforeseen pressures in the wild.

Compare this random selection to the "Orange line." Again the colorful name is based on the color of the buckets used for these selections. This method will exclude certain beetles based on size, or obvious deformities, like malformed elytra. The reasoning behind this is that in the wild, there is sometimes competition for carrion resources. In this competition, beetles that are drastically smaller, have little chance to dominate larger beetles. So, for instance, all beetles less than one gram in weight are not considered for breeding. Likewise, beetles with visible deformities that would prevent flying, are not considered. Since this is the method that has proven successful for so many generations, the choice to change mate selection methodology is not made lightly. Comparing the two methods side by side, with no other significant variables, other than the mate selection will give us an extremely valuable comparison for future generations and other ex situ breeding programs for these beetles. The fact that our protocol also requires that we record brood size/ production numbers, weights, and biometric measurements, means that we can compare trends between the two lines over several generations. And because of the short generation times - compared to vertebrates, this study could have very interesting implications for future breeding programs.

Since we began this project, we have had some great success. Beginning in 2005 with four beetles, we have produced over 9,300 beetles and have recorded the weights and pronotal widths of all but the very earliest 722 beetles. This measurement was added to our protocols because we saw the value of tracking biometric trends in relation to the health of the captive population. We have 839 pairings within our 28 generations of beetles. We then have the longest continuous captive population of ABBs. Our record keeping allows us to be able to trace every beetle all the way back to the beetles that came from the wild. This data and information has been useful for improving health, care, and production of this endangered species. It has also helped us to partner with the Patty Parker Lab at the University of Missouri-Saint Louis to conduct research into the genetic relatedness of several disparate wild populations of ABBs. This could point to genetic difference in isolated wild populations, as well as give us insight into the impact our different methods of mate selection may have on a closed colony like ours.

Reintroduction-- The Saint Louis Zoo contributed to a reintroduction effort in Ohio for over seven years, contributing both personnel and thousands of beetles. During that time, we contributed 1,451 pairs of American Burying Beetles and staff to assist in digging burial chambers to put them back into the wild. In many ways, we viewed this as training period for our staff. Every full-time staff member assisted with these Ohio reintroductions. We also observed different reintroduction methodology over those years and were able to formulate a plan moving forward to reintroduce closer to home in Missouri.

So far, in Missouri, we have conducted four reintroductions to Wah' Kon-Tah Prairie close to El Dorado Springs, MO. We have released 744 pairs in that four year time span. And, we have had success.

We are finding offspring produced from these reintroduced beetles in both fall and spring surveys. They are reproducing in the wild. Pairs are chosen using the same methodologies we use in the lab. For the past several years, we have divided up one big reintroduction into two distinctly separate ones in order to do what is best for beetle. This way we do not have all our metaphorical eggs in one basket. Our intent is to give each pair the best chance of breeding and successfully producing larvae in order to produce the most genetically diverse group for the reintroduction site.

We saw various different approaches of reintroducing ABBs back into the wild while assisting in Ohio, and after reading accounts from reintroductions on Pekinese Island and Nantucket Island in Massachusetts. We then chose what we felt would work best for our site and set firm protocols up for our reintroduction of ABBs to Wah' Kon-Tah Prairie.

We first surveyed the prairie (along with many other sites throughout Missouri) for a number of years to make sure that there were no existing ABBs on the prairie. We also made sure that the reintroduction site had a suitable amount of appropriate-sized carrion sources available to the ABBs. The next step was getting permission from United States Fish and Wildlife Service for reintroduction. We also worked with our other partners, the Missouri Department of Conservation and The Nature Conservancy. They own and manage the prairie. They all were onboard and excited about the first Federally Endangered Species reintroduced into Missouri.

Beetles are first chosen based on maintaining the Zoo's colony for future reintroductions. So, we first choose the ones needed to keep back for the colony with best choices considering relationship. This is usually three males and three females from each bucket/brood. Then every pair is chosen, using the same criteria as we do for the lab colony. Then we divide all pairings up for the two reintroductions. Then, we further divide for our three reintroductions sites located on the prairie. We notch each beetle on the elytra with a surgical cautery tool to note the specific reintroduction site. The pairs are placed in transport containers and then "rubber banded" together so it is clear which male goes with which female. The beetles are then packed in a large insulated box with ice packs to keep them cool in transportation.

On the day of the reintroduction, we lay out transects with string, placing marking tape every0 .91 m (3 feet). The marking tape is used as a guide for where to dig plugs. This gives us a plug about0.45 m (1 ½ foot) apart. The plugs are about the size of a dinner plate. The soil plugs are removed so they are tapered like a cork, cut at an angle. This is so when they are put back in, they will fit tightly. The hole is then cleaned up a bit, and made a few inches deeper to create a place for rain water to run to instead of the side brood chamber. The side brood chambers are dug about 7.62 to 10.16 cm (3 to 4 inches) from top of soil, in side of the hole. They are about the size of a softball. This is so we can fit a quail in the side chamber for the pairs. We then place a dead quail in each side chamber and inspect every hole and chamber to make sure that they meet our standards. The pair is carried to hole; each individual is placed on the quail gently. They are allowed to settle in and stay with the quail in hole. This is all done in the late afternoon so if they do come up the beetles will not be coming up in the heat of the day. The plug is gently put back in hole and loose soil is put around the crack to seal it. This helps to cut down on smell of

the quail not to draw in predators that could dig them up or disturb the pairing. The cracks are also seal up to prevent rain running in cracks somewhat. Poultry wire is then laid out over all the plugs and staked down. This is to prevent mammalian scavengers from getting to quail and beetles.

We then go back 10 days later to check 1/3rd of the broods to get idea of breeding success. We pull up the wire on one side, remove the plug and write down what we see - If there are larvae, if parents are there, or if it has been abandoned. Incidentally, we have observed that they may move the quail from the brood chamber, but this seems to have no detrimental impact. We note notches as well, as we have found that wild beetles come in and mate with reintroduced beetles when their mate dies. Sometimes when it rains a lot we typically find only rotten quail in abandoned chambers. But, encouragingly, usually see no dead beetles. They likely abandoned the carcass and are off breeding elsewhere nearby with another natural carrion resource.

After 20 days we remove the wire to reuse next year. The quail is gone and larvae are in their pupation cells at this point.

We survey after 60 days to see how many new beetles we find. We have found both new, un-notched beetles in fall and in spring every year since we began the reintroductions. It is also encouraging that the numbers of new beetles found are getting larger every year. This spring, so far we are up to 30 new un-notched beetles. This is showing us that they are reproducing at the site.

We still have questions: Are they established? What is the carrying load on prairie for ABBs? When do we just monitor them and stop reintroductions? These questions will be answered as we go along working with them and monitoring them on the prairie.

Conclusion-- I am very proud of the success of our program here at the Saint Louis Zoo and feel very privileged to be a key person in the recovery of this amazing beetle. I love the challenge of raising this beetle and having the success we have had at Saint Louis. The success is because the crew and I are passionate about giving the best care to the ABBs. We want to be successful in reintroducing them back into the wild. We do it because we want to do the best for the beetle or any animal we care for. I have loved the challenges of working with the husbandry and care of this beetle. I continually work and strive to find the best ways to raise ABBs and improve on our processes. I always feel there is room for improvement and no such thing as perfection. I am glad I accepted the challenge of raising the American Burying Beetle here at the Saint Louis Zoo.

Acknowledgments:

Thanks to Ed Spevak, my Curator and Bob Merz, my Zoological Manager for trusting me and listening to me when I have ideas, changes I'd like to implement, from pairing choices to husbandry tweaks or concerns.

Thanks to Glenn Frei for his crazy obsession to write a program on Excel that works best for both the beetle, the crew entering the information and me.

Thanks to the crew for all their input and work to make the ABB program at Saint Louis Zoo so successful.

I could not have done any of this without everything and everyone working to be the best for the ABBs.

REFERENCES

Amaral, M., A Kozol and T. French (1997): “Conservation Status and Reintroduction of the Endangered American Burying Beetle”: Northeastern Naturalist 4: 121-132

“Rain Forest Review”

A Primate Natural Behavior Show

By

Jeannette Schwab, Animal Keeper

Cheyenne Mountain Zoo

Colorado Springs, Colorado

Introduction

In 2007, Natural Encounters Inc. was invited to Cheyenne Mountain Zoo to help us develop natural behavior shows with our animal collection. Steve Martin and Wouter Stellard from Natural Encounters Inc. spent several months teaching us the art of public speaking and animal training. During this time is when our show “Rain Forest Review” was developed. Our challenge was to showcase our primate collection so that our guests could see past our antiquated building and fall in love with our awesome animals. We hoped to educate our guests on conservation issues and inspire them to take conservation actions in their everyday lives.

In order to do that we needed to decide what behaviors we wanted to train, set up our exhibits for our behaviors, train the behaviors, come up with dialog for the show, decide on conservation messaging and create an opportunity for guests to participate in the show. In the first year we decided to train at least one animal in each exhibit to do a natural behavior as we talked about their special adaptation for life in the forest. We would tour our guests around the building starting at one end of our semi-circular shaped building and move around to each of our indoor enclosures. The show took about 10 to 15 minutes to complete. As our show developed we added more behaviors for each primate to do, we improved our dialog and moved the show location from our indoor enclosures to our outdoor enclosures.

Methods

Our building, Monkey Pavilion, was built in the 1960’s and has eight indoor exhibits and three outdoor exhibits. When the building was first built it use to house a variety of feline species but later was renovated to house a wide variety of primates. We have Black crested mangabeys (*Lophocebus aterrimus*), Sykes guenon (*Cercopithecus albogularis*), Wolf’s guenon (*Cercopithecus wolfi*), Ring-tailed lemurs (*Lemur catta*), Black and white ruffed lemurs (*Varecia veriegata*), Lar gibbons (*Hylobates lar*), White cheeked gibbons (*Nomascus leucogenys*) and Black howler monkeys (*Alouatta caraya*). All of which have been in our show from time to time and have demonstrated various natural behaviors. The behaviors that we chose highlighted each species abilities and special adaptations. Once we decided what our behaviors were going to be we were able to design our exhibits. Monkey Pavilion’s Keeper staff does all in house exhibit design and we install all of our own perching. This allows us to set up our enclosures to accommodate the natural behavior we want to train. We didn’t start from scratch on each enclosure but we were able to move ropes around, put a tree up where we needed one, build a

platform and strategically place other furniture around the exhibit. When the exhibit was ready we started training our behaviors.

Fig. 1 Jeannette Schwab doing the show inside Monkey Pavilion

All the exhibit fronts are bars, instead of glass, so we were able to train from the front of each enclosure. Around the enclosures is a 5 foot fenced off area where we are able to stand and the guests could watch us train. There are three keepers who work in Monkey Pavilion so we each took on several groups of primates to train as their primary trainer. Each trainer worked on their behaviors for the show and then generalized the behaviors to the other keepers. It didn't take long to train one animal from each group to do a behavior and then add it into the show. Before long the animals had 2 to 4 behaviors each and the show was about 15 to 20 minutes long. Each year we wanted to improve the show and add more elements. The first 3 years we did the show inside our building but decided that we could have the animals do bigger behaviors in our larger outdoor enclosures. We also wanted to improve our conservation message and to create a way for our guests to have a personal experience.

Fig 2 Working with a White cheek gibbon during the show.

We wanted the show to start with a big behavior and end with an even bigger behavior to draw the guests in and to leave them feeling amazed. We trained lots of different behaviors that showed all sorts of adaptations that the primates had. Behaviors like leaping, jumping, balancing, brachiating, hanging by their feet, stuffing cheek pouches and presenting body parts like hands, tails and ischial callosities.

Fig. 3 Black and white ruffed lemurs getting into position to hang upside down by their feet in their outdoor enclosure.

Fig.4 Black and white ruffed lemur balancing on ropes.

Our current show that we do on our outdoor enclosures is really fun and fast paced. Our two Black and white ruffed lemurs, Rizzo and Ozzie, simultaneously hang upside down by their feet to show how they have opposable toes and are able to feed upside down. Ozzie walks under and over ropes to show agility and balance. Then he reveals our conservation message by pulling down a sign with the Forrest Stewardship Council (FSC) logo on it. We move to the next enclosure where, Tana, our Black crested Mangabey is waiting. He presents his tail and ischial callosities, does two different agility courses and then stuffs his cheek pouches. After that Tana shifts inside and our White cheeked gibbon, Tanh-Linh, runs out to station. He presents his

hand, does a back flip while hanging onto the enclosure and then brachiates around the exhibit. For his finale he does a big leap across the entire enclosure. Once he is done we move him off to the back of the exhibit and then shift out our last primate, Debbie, Tanh-Linh's mate. She runs out carrying a kong® toy that has a piece of paper with our conservation message on it. She hands it to the trainer and then stations and catches treats while we talk about the message.

Fig. 5 Black crested mangabeys showing his tail and ischial callosities.

Fig. 5 Black crested mangabeys rope walking.

In the beginning each trainer came up with their own dialog for the show. The dialog stuck with our theme but it was not scripted. Our theme was how primates use their special adaptation to get around and survive in their forest habitats. We talked about the behaviors the animals were doing and added other fun facts and information. This allowed the show to be a little different depending on which keeper was doing the show. As the show evolved we decided to add an interpreter to the show instead of having the trainer do the dialog and all the training by themselves. The interpreters came and watched us do the show and learned the general dialog. The show became more scripted at this point but still maintained the same theme. Adding the interpreter to the show helped us to polish up the entire demo. The interpreter could focus on the guests and the trainer could focus on the training. This helped the trainer to watch the animals more closely and keep them from throwing out the behaviors before they were cued.

Fig. 6 White cheek gibbon leaping across the exhibit.

Fig 7 White cheeked gibbon hanging out with the crowd.

The last part of our show is where the guests can participate. After Debbie gibbon gives the kong® to the trainer, the trainer gives the kong® to the interpreter. The interpreter asks for a volunteer and the volunteer pulls the message out of the kong® and shows all the guests the message. The piece of paper has the FSC logo on it. We wanted one consistent message that our guests could take home with them and have as an action step. We chose the Forest Stewardship Council as our conservation message because we felt that it was important to save the forests where these animals live out in the wild. By buying products that come from sustainably harvested forests the guests could save habitat where our primates come from. The interpreter talks about the Forest Stewardship Council for the second time during the show and tells the guest about how they can help save species by looking for this logo on products they buy made out of wood. She then asks the guests if anyone can name a product they could buy with the FSC logo on it. The volunteer who revealed the message and the guest who answered the question get to make enrichment for the gibbons. We have them wash their hands with hand sanitizer and make what we call “Cannoli’s”. The guests fill a paper tube with dried fruit and cereal. They are then able to toss the cannoli to Debbie gibbon. Debbie catches the cannoli and tears it apart. We conclude our show by thanking the guests for watching our show and spend a few minutes answering question as people leave the show area.

Fig 8 Joanna Husby makes cannoli's with the kids.

Fig. 9 Black and white ruffed lemur reveals the FSC logo.

Conclusion

The show has gone through many changes over the years and we have greatly improved all aspects of the demonstration. It is a very well put together show and has many exciting things to share with our guests. It has allowed us to accomplish our goals by melting away the old exhibit design and create memorable guest experiences for everyone who sees our show. Every day I can see in our guest faces that we are accomplishing everything we set out to do. People are amazed by these awesome animals and by what they can do. It has allowed our animals to do their jobs by inspiring quests to take conservation action and help save species in the wild.

“ Female Aggression Dynamics and Hormone Fluctuations in Black and White Ruffed Lemurs (*Varecia variegata*)”

By
Alicia Marty, River’s Edge Keeper
Saint Louis Zoo
St. Louis, Missouri

Introduction
Black and white ruffed lemurs (*Varecia variegata*) are critically endangered primates from the Northeastern rainforests of Madagascar. This species shows clear female dominance during both feeding and social contexts (Kaufman 1991, Raps & White 1995, Overdorff et al. 2005). There is an age-reversed dominance hierarchy in which daughters typically outrank their mothers by the age of 3 (White et al. 1992, White 2009). This has created significant challenges for managing captive family groups because the dominant individual is often aggressive towards subordinates. While aggressive interactions can be important for maintaining the dominance hierarchy, these interactions can infrequently result in injury and can lead animal managers to temporarily separate individuals, or in some cases, reconfigure the social groups entirely (Porton, pers comm). This management strategy is not ideal for a social primate in which interaction with conspecifics is crucial for development. Furthermore, separation and animal transfers can be stressful events that should be avoided if possible.

Black and white ruffed lemurs are strictly seasonal breeders, with the breeding season occurring between May and July in Madagascar; however, because of the opposite seasonality between hemispheres, the breeding season occurs December through February in the Northern hemisphere (Shideler & Lindburg 1982, Boskoff 1977). For the majority of the year, the female’s vulva is impenetrable, except during a short window of estrous. During estrous, the female’s vulva swells, changes from black coloration to bright pink, and opens for a period lasting 24 to 72 hours (Boskoff 1977, Foerg 1982). This external presentation of estrous allows animal managers to regularly record reproductive status in captive females throughout the breeding season.

A consistent part of a captive animal’s environment is enrichment; which makes it an ideal solution for solving management issues. Enrichment can come in many forms and can be purely sensory or encourage feeding or foraging behavior. Zoos have used feeding enrichment devices in a variety of ways to influence an animals’ behavior, including minimizing aggression. A previous study examining the effects of enrichment showed decreased levels of intraspecific aggression as well as interspecific aggression between black and white ruffed lemurs and ring-tailed lemur (*Lemur catta)* in mixed species exhibits when food was presented in enrichment devices (Zimmerman & Feistner 1996). However, a study examining intrasex aggression, particularly during the breeding season, for black and white ruffed lemurs is absent from the literature. In addition to understanding female aggression dyanamics, this study examines the influence of two feeding enrichment strategies and their management implications.

In addition to understanding the behavioral effects of intragroup aggression, it is necessary to begin understanding the underlying physiological states that can influence behavior. Specifically, monitoring fecal glucocorticoids (fGC) can indicate whether an individual has chronically high stress levels, which have been shown to be an indicator of higher mortality rates in a related species (*L. catta*, Pride 2005). Furthermore, a study on wild ring-tailed lemurs shows higher fGC levels in dominant individuals (i.e. the individuals who initiate more aggressive interactions) (Cavigelli et al. 2003). By determining the levels of stress related hormones in females living in both multi-female and single-female groups, it is possible to determine which housing strategy is the most beneficial both socially and physiologically.

Because of their threatened status, this species is managed in captivity under an SSP. Captive-bred individuals have been successfully released into the wild in the past (released from 1997-2001, Britt et al. 2004); and the population must be managed as if this is a possibility in the future. Therefore, maintaining natural behaviors, groupings, and social interactions is paramount. In the wild, this species can be found in multi-female multi-male groups of up to 30 individuals when resources are plentiful (Pereira et al. 1988). There is evidence of social learning in this species, as well as direct mother-offspring exchange of information crucial to survival, thus maintaining natural relationships

and behaviors will have lasting effects as these individuals reproduce in captivity (Stoinski et al. 2011). Increased aggression between females can lead animal managers to separate females for prolonged periods of time, eliminating adult female interactions. These practices may result in decreased social development and stimulation for individuals involved and would ultimately decrease their candidacy for reintroduction programs in the future.

Beyond the conservation significance of maintaining a healthy captive population, this study serves the purpose of clarifying the potential causes of heightened aggression between females and can lead to the establishment of a management plan to keep multi-female groups together long-term. Incorporating the behavioral study with the endocrine data will allow us to determine a threshold of acceptable levels of aggression within a group. If it is determined that any number of the individuals is chronically stressed throughout the duration of the breeding season, mitigation techniques will need to be implemented to reduce the stress on the individuals if possible. Furthermore, collecting and analyzing survey data from all AZA accredited institutions housing multi-female groups will lead to a better understanding of the scope of this management complication and the importance of determining mitigation strategies.

This study uses a survey of 10 AZA accredited institutions to determine the breadth of this management complication in multi-female groups. The Saint Louis Zoo's black and white ruffed lemur population is an ideal case study for identifying potential mitigation techniques because they currently house 2 groups: a multi-female group and a single female group. The family group consists of a breeding pair and their 4 offspring, totaling 3 females and 3 males. The second group is comprised of 1 breeding female and 2 males, both of which are genetically appropriate matches for the female.

Methods

The survey was conducted during February 2015 using the online survey website SurveyMonkey. The 2014 North American Regional Studbook for Ruffed Lemurs (Whipple 2014) and the Population Analysis & Breeding and Transfer Plan (Eddie, et al. 2015) were used to determine ideal survey participants. It was sent to the 11 AZA accredited zoos that currently house multi-female groups of black and white ruffed lemurs. The questions were focused on intragroup aggression with additional questions for institutions that indicated heightened aggression in their groups, both intra and intersex.

Behavioral observations were conducted on the multi-female group from 01 December 2014 through 28 February 2015, totaling 104 30-minute observation sessions. Behavioral observations were not conducted on the single-female group because intrasex aggression was the main focus of the study. To measure the influence of enrichment on agonistic interactions, food was presented in two different feeding enrichment devices; one feeding device is considered easy for the animals to retrieve the food and the second device is considered hard. The easy devices are hanging bowls in which all diet items are presented in bowls hanging from multiple plastic chains. These require little to no manipulation and time commitment from the animal to retrieve a diet item. The hard devices are suet feeders, which provide the animals with a challenge to retrieve the diet items. The animals must use their hands and teeth to manipulate and pull the diet items through the holes in the wire mesh. The suet feeders require a prolonged time commitment from the animal compared to the hanging bowls. There were 6 enrichment devices offered each day in the exact same locations – 1 per animal to eliminate competition over limited feeding stations. The diet items rotated based on availability, but no "high quality" items such as fruit or special treats were presented to the animals on observation days. Diet items consisted of a rotation of vegetables and starches, a rotation of leafy greens, and primate chow.

On each observation day, the group was observed for 30 minutes coinciding with their AM feeding and again for 30 minutes during the PM feeding. The group was shifted into the off-exhibit area prior to the beginning of each observation, food was placed on exhibit in the specified feeding enrichment devices, and the observation began the moment the shift door opened to give the animals access to the public exhibit. Of the 4 observation days per week, there were 2 days in which each enrichment type was used. This led to a final sample size of 52 observation periods for each enrichment device.

Observers were stationed on the public side of the exhibit and recorded all occurrences of ethogram behaviors, which included chase, charge, cuff, a charge/cuff sequence, and displace, described by Pereira et al. (1988). The information recorded for each behavior included: exact time, location in the exhibit, the individual that initiated the

agonism, the recipient of the agonism, and the specific behavior observed. In addition to the live observations, video recordings were taken from 4 different angles. By having both a live observer and the video recordings it was possible to accurately identify the individuals in real time, and watch the interactions repeatedly to gather detailed information.

Every morning, individuals were given 1.0mL of non-toxic food coloring on a diet item. Each individual was given a unique color, allowing the animal keepers to collect fecal samples from each individual with 100% certainty. Keepers collected the fecal samples non-invasively by entering the exhibit area while the animals were secured in an off-exhibit location. The samples were immediately frozen. Fecal samples (total n=360) were extracted using a 1:1 solution of phosphate-buffered saline and Methanol. The samples were then shaken overnight and the liquid was poured off of the solid fecal material the next morning. The liquid was then centrifuged and the remaining liquid was used for the radioimmunoassay. The process of the radioimmunoassay involves placing the sample (the hormone level to be measured) with a measured amount of antibody as well as a measured amount of radioactively tagged cortisol. Through competition, the hormones in the samples compete with the radioactive hormones for binding sites on the antibodies. When the solution is put into a Gamma Counter, the amount of radioactively tagged hormone is measured and through deduction, it is possible to determine the level of hormone in the sample. All assays were conducted at the Saint Louis Zoo's Endocrinology Lab.

Results

The survey was sent to 11 AZA accredited zoos that housed multi-female groups as of February 2015. Of the 11 zoos contacted, 10 responded, resulting in a response rate of 90.91%. Of the 10 respondents, 7 reported heightened aggression within their groups. Within the 7 institutions reporting high aggression, daughters aggressing towards their mothers occurred the most often (37.5% of respondents), followed by mothers aggressing towards their daughters (25%), and agonism between sisters, unrelated females, and males occurred least frequently (12.5% for each). Additionally, 57.14% of the zoos reporting heightened aggression also noted that the agonistic interactions have resulted in injuries.

In the multi-female group of black and white ruffed lemurs at the Saint Louis Zoo, there was significantly higher enrichment use on days when the diet was presented in suet feeders, rather than hanging bowls ($p<0.000$; ANOVA). Aggression was higher on suet feeder days when inter- and intrasex interaction data were pooled ($p=0.058$; ANOVA). When only female-female aggressive interactions were evaluated, this positive relationship between suet feeders and aggression was not as strong, but still approaching significance ($p=0.105$; ANOVA).

The endocrine data showed a significant difference in the glucocorticoid profiles for the 3 females in the multi-female group ($p=0.034$; ANOVA). However, a highly significant difference existed between the adult female in the multi-female group (52.78 ± 9.66 ng/g) and the adult female in the single-female group (17.79 ± 1.48 ng/g) ($p<0.000$; ANOVA) (Table 1). Additionally, none of the females involved indicated chronic stress throughout the breeding season, with the majority of peaks lasting only one day.

Table 1.

Group	**Individual**	**Average fGC ± SE**
Multi-female	Adult Female	52.78 ± 9.66 ng/g
Multi-female	Dominant Daughter	31.99 ± 5.98 ng/g
Multi-female	Subordinate Daughter	29.14 ± 4.21 ng/g
Single-female	Adult Female	17.79 ± 1.48 ng/g

Table 1: Average fecal glucocorticoids (fGC) ± standard error for the females in the multi-female group and the single-female group. Fecal samples were collected daily from each female from 01 December 2014 through 28 February 2015.

Discussion

The survey results indicate that there is a management complication with housing multiple female black and white ruffed lemurs in the same social group, with 70% of survey respondents reporting heightened aggression. This is further supported by the fact that over half of these institutions report that injuries have resulted from the aggression.

Therefore, to provide the most suitable and healthy social groupings for this species, determining any underlying causes and possible solutions is of paramount importance.

The results of the case study at the Saint Louis Zoo show that enrichment may play a role in the levels of aggression within multi-female groups. While many enrichment studies indicate that the presence of more complex enrichment can lower aggression (Zimmermann et al., 1996), our results show that while the animals are more active on the days with the more complex enrichment, they are also significantly more aggressive. This may indicate that higher activity can lead to higher agonism, or that the dominant female is more compelled to monopolize the enrichment when more time is required to retrieve the food. Although there were enough enrichment items presented for each individual to participate, this may have caused the dominant female to actively "patrol" or "guard" the enrichment stations. Individuals were required to commit more time to retrieving food from the suet feeders, which may have made subordinates less vigilant and potentially more of a target for the dominant female.

The endocrine results for this case study suggest that it is more stressful to live in a multi-female group. The highly significant difference between the adult females in the two social settings is remarkable and should be investigated further. By increasing the sample size and incorporating other females from both social settings, the relationship between social grouping and stress levels can become clearer. Large groupings with multiple females and males are considered to be a normal social group in the wild; therefore, determining ways to successfully replicate this in a captive setting can benefit the individuals involved. Group separation and animal transfers have the potential to be stressful experiences and should not be the first option considered when group aggression occurs.

Bibliography

Boskoff, K.J. 1977. Aspects of Reproduction in Ruffed Lemurs (*Lemur variegatus*). *Folia Primatologica* 28.4: 241-50.

Britt, Adam, Charles Welch, Andrea Katz, Bernard Iambana, Ingrid Porton, Randall Junge, Graham Crawford, Cathy Williams, and David Haring. 2004. The Re-stocking of Captive-bred Ruffed Lemurs (*Varecia variegata variegata*) into the Betampona Reserve, Madagascar: Methodology and Recommendations. *Biodiversity and Conservation* 13.3: 635-57.

Brockman, Diane K., Mary S. Willis, and William B. Karesh. 1987. Management and husbandry of ruffed lemurs, Varecia variegata, at the San Diego Zoo. II. Reproduction, pregnancy, parturition, litter size, infant care, and reintroduction of hand-raised infants. *Zoo biology* 6.4: 349-363.

Cavigelli, S.a, T. Dubovick, W. Levash, A. Jolly, and A. Pitts. 2003. Female Dominance Status and Fecal Corticoids in a Cooperative Breeder with Low Reproductive Skew: Ring-tailed Lemurs (*Lemur catta*). *Hormones and Behavior* 43.1: 166-79.

Eddie, Christie, Britt Keith, Mylisa Whipple, and Gina M. Ferrie. 2015. Population Analysis & Breeding and Transfer Plan - Black and White Ruffed Lemur (*Varecia variegata*). Association of Zoos and Aquariums.

Foerg, Renate. (1982). Reproductive Behavior in *Varecia variegata*. *Folia Primatol* 38: 108-21.

Kaufman, Ruben. 1991. Female Dominance in Semifree-Ranging Black-and-White Ruffed Lemurs, *Varecia variegata variegata*. *Folia Primatologica* 57.1: 39-41.

Myers, Norman, Russell A. Mittermeier, Cristina G. Mittermeier, Gustavo A. B. da Fonseca, and Jennifer Kent. 2000. Biodiversity Hotspots For Conservation Priorities. *Nature* 403: 853–858.

Overdorff, Deborah J., Elizabeth M. Erhart, and Thomas Mutschler. 2005. Does Female Dominance Facilitate Feeding Priority in Black-and-white Ruffed Lemurs (Varecia Variegata) in Southeastern Madagascar? *American Journal of Primatology* 66.1:7-22.

Pereira, Michael E., Martha L. Seeligson, and Joseph M. Macedonia. 1988. The Behavioral Repertoire of the Black-and-White Ruffed Lemur, *Varecia variegata variegata* (Primates: Lemuridae). *Folia Primatol* 51: 1-32.

Porton, Ingrid. Personal communication. February 2014.

Pride, R. Ethan. 2005. High Faecal Glucocorticoid Levels Predict Mortality in Ring-tailed Lemurs (*Lemur catta*). *Biology Letters* 1.1: 60-63.

Raps, Stefan, and Frances J. White. 1995. Female Social Dominance in Semi-Free-Ranging Ruffed Lemurs *(Varecia variegata). Folia Primatologica* 65.3:163-68.

Shideler, Susan E., and Donald G. Lindburg. 1982. Selected Aspects Of *Lemur variegatus* Reproductive Biology. *Zoo Biology* 1.2: 127-34.

Stoinski, T. S., L. A. Drayton, and E. E. Price. 2011. Evidence of Social Learning in black-and-white ruffed lemurs (*Varecia variegata*). *Biology Letters:* 7: 376-379.

Whipple, Mylisa. 2014. North American Regional Studbook for Ruffed Lemurs - Black and White Ruffed Lemur (*Varecia variegata*) Red Ruffed Lemur (*Varecia rubra*). Association of Zoos and Aquariums.

White, Frances J. 2009. Sex Ratio at Birth and Age-Reversed Dominance among Female *Varecia*. *Folia Primatologica* 80.5:341-52.

White, Frances J., Ann S. Burton, Susan Buchholz, and Kenneth E. Glander. 1992. Social Organization of Free-ranging Ruffed Lemurs,Varecia Variegata Variegata: Mother-adult Daughter Relationship. *American Journal of Primatology* 28.4: 281-87.

Zimmermann, Alexandra, and Anna T. C. Feistner. 1996. Effects of Feeding Enrichment on Ruffed Lemurs *Varecia variegata variegata* and *Varecia v. rubra*. *Dodo, J. Wildl. Preserv. Trusts* 32: 67-75.

Birds of a Feather Don't Always Flock Together: Training Southern Cassowary for Voluntary Injections in a Protected Contact Environment

By
Samantha Kaeser, Zoo Keeper
Brevard Zoo
Melbourne, Florida

Abstract

An outbreak of encephalitis in the fall of 2014 prompted the need to vaccinate Brevard Zoo's ratites against the deadly disease. The Austral-Asia keeper team was tasked with training the zoo's two 1.1 Southern cassowary (*Casuarius casuarius*) to stand for voluntary injections in a protected contact environment. The cassowaries have two distinctively different personalities. When training began, keepers quickly had to modify the training plan for each individual bird. Small approximations and inventive thinking helped shape the desired behavior from the male. The female required much more time as well as modification of the behavior's criteria to make the training plan successful. Both cassowaries successfully achieved the behavior and were able to be vaccinated with less stress to them, to the vet staff, and to the keepers.

Introduction

Brevard Zoo houses two 1.1 Southern cassowary, Sydney and Ginger. Each has its own yard, separated by fencing and foliage. Both have sliding doors that access an outdoor, shared shifting area with access to a barn stall. The keepers refer to the shifting area as the "airlock." This is where both cassowaries are trained and where most of our interactions with Sydney and Ginger take place.

With some recent cassowary deaths in the United States due to encephalitis, we knew we had to vaccinate quickly, but we wanted to achieve this in the least intrusive, most positive way possible. Both Sydney and Ginger had previously been target and scale trained as well as trained to shift into a barn stall, so we knew how motivated and trainable they could be. We had confidence that we could set them both up to experience the least amount of stress possible to make the injection procedure successful. The vaccination that was administered to both cassowaries was for West Nile virus, Venezuelan equine encephalitis virus, Western and Eastern equine encephalitis virus, and Tetanus.

Personality challenges

Sydney and Ginger are two individuals with contrasting personalities. Sydney is animated and feisty most of the time. He has a high energy level and frequently displays chest bumping towards people along the fence line. He will calm down around his keepers and during training sessions. This energetic eagerness helped him progress quickly in his training because we could create behavioral momentum during sessions to progress faster.

Compared to Sydney, Ginger is mellow. She's slower to move, in general, and has a more lackadaisical attitude, except during breeding season. She is leery and stand-offish about new situations whereas Sydney will investigate new things and even display typical cassowary aggressiveness. Ginger's personality and a medical issue added to the amount of time it took for Ginger to learn the behavior, but in the end, she was successfully vaccinated with minimal stress.

Methods

Neither cassowary had been trained with more than one keeper present. To desensitize them to having more than one person present, I had another keeper, Ellen, stand next to me while I asked them for basic targeting behaviors. Sydney required one training session to become comfortable performing behaviors with more than one person present. Ginger required three training sessions with two people present before she would perform any behaviors.

After desensitizing the cassowaries to multiple people, I had Ellen stand with a long, skinny bamboo stick in her hand. We used the bamboo stick as our mock injection pole. The bamboo stick was presented through the fence after the cassowary did not react to the second trainer holding it. The bamboo was eventually replaced with an injection pole and blunted needle to desensitize them to the poke of the needle.

When the bamboo pole was placed through the fence, Sydney investigated it right away. He tried to target the bamboo stick. He also became aggressive towards the bamboo a couple of times by chest bumping and hissing at it. When he realized he only received reinforcement for ignoring the stick, he quickly learned to ignore it regardless of its proximity to him.

Desensitizing Ginger to the bamboo stick through the fence was a little more challenging. Ginger would come to her usual training spot along the airlock fence, but as soon as the stick was placed through the fence, she would immediately stop training. She would remain standing in the same place, but she refused to perform any behaviors asked of her.

I tried placing the bamboo stick through the fence before opening the shift door to give her access to the airlock. She would come into the airlock but would not train while the stick was through the fence. It took four more sessions and a lot of patience on my part before Ginger was comfortable with the bamboo stick through the fence. She eventually did try to target the bamboo, but, like Sydney, she realized she only received reinforcement for ignoring the stick and began to train normally with the bamboo in place. Both birds became so comfortable and desensitized to the bamboo and then the mock injection pole that, by the end of the training, both were leaning into the pole when it was touched to their bodies.

Their previous targeting criteria was also a small challenge I had to overcome. Both cassowaries were target trained, but the criteria for targeting was just touching the pole anywhere with their beaks. When both of them targeted, they tended to touch the end of the target pole, a large, wood dowel rod painted blue. This meant that they were usually facing towards the front of the trainer. To receive the injections, they needed to be lined up with their bodies parallel to the fence line. It took quite a few training sessions of only rewarding the

touching of the side of the target pole before I started the actual “line-up” behavior. When the birds were required to touch the side of the target pole, they tended to assume a more sideways stance rather than facing me head-on. This helped to capture the body positioning I needed.

Training Sydney

During our earlier sessions, I noticed that when I faced toward Sydney, he would look head-on as well, sometimes chest bumping the fence. When I faced sideways/parallel to the fence, Sydney tended to remain sideways as well. To achieve the line-up behavior, I began targeting Sydney on one side of the fence then walking forward a few steps and quickly targeting him again. He was only bridged when he touched the target and stayed sideways. He soon caught on that he would not be rewarded if he tried to face me. A verbal cue of “line up” was paired with a visual cue of swinging an arm while the initial target was faded out (see fig.1). I had to get longer tongs for administering the reward so the reward was given in front of his face while he was still parallel. With shorter tongs or by hand, he would turn his entire body towards me to receive the reward, breaking his parallel stance.

Sydney had his official vaccination injection performed by our veterinarian after only 15 training sessions (see fig. 2).

Figure 1. Sydney lining up

Figure 2. Sydney receiving injection

Training Ginger

Ginger has always been less motivated than Sydney when it comes to most things. When asked to target, she was very slow to take steps towards the target and would try to stretch her neck and body as far as she could to reach the target to avoid picking up a foot to step forward. Her training progressed more slowly because of this. I had to be stricter with her targeting criteria and would place the target just out of her reach so she would have to take a step. Although, if

the target were placed too far away and I asked her to move more than one or two small steps, she refused to perform the target behavior at all, no matter what kind of tasty reward was waiting for her. Ginger's "line-up" behavior was eventually accomplished successfully by using small approximations of targeting her. I asked her to take small steps toward the target to move her into the parallel position with her body close to the fence, the perfect posture to receive an injection.

There was a small setback with Ginger's training when she started having some medical issues. She started to lose feathers on her left thigh and underside of her body (see fig. 3). She was also exhibiting an abnormal gait. First, she began walking with a small hitch in her step. Then, the hitch progressed to a strong limp. She was anesthetized for an exam and treated with Meloxicam (non-steroidal anti-inflammatory), Ceftiofure crystalline free acid (long-acting antibiotic) and Normosol-R (fluids). The medical procedure made her leery of keepers for the next week, but the injections she was given did improve her condition. Training for both birds was put on hold until we could get Ginger comfortable and back into her usual shifting procedure. For the most part, the effects of the procedure to Ginger's behavior were minimal. To set Ginger up for training success, I took it slow and regressed to the basics when getting back into her scheduled training. For the first few sessions, I lowered her new targeting criteria and rewarded her for targeting anywhere within the training area. She was still required to target the side of the target pole and was not rewarded for touching the end of the pole. Ginger received her vaccination after 25 training sessions.

Figure 3. Ginger's feather loss

Conclusion

Ultimately, the experience of voluntary-injection training our two cassowaries has showed us that two different personalities cannot be trained the same way. The training plans have to be constantly changing and evolving to accommodate each individual. Observations of the animals and how the trainer interacts and reacts to each individual are essential to training success.

The line-up behavior that was trained can be used not only for voluntary injections, but also as an initial base behavior for many other husbandry procedures including physical exams. Currently, the keepers have been using the cue to work on tactile training with Ginger.

Bibliography

Ramirez, Ken. *Animal Training: Successful Animal Management Through Positive Reinforcement*. Chicago, IL: Shedd Aquarium, 1999. Print.

Using a GoPro camera to enhance animal husbandry at Disney's Animal Kingdom®

By

Nick Milone and Carlos Torrez, Trails Keepers

Disney's Animal Kingdom®

Lake Buena Vista, Florida, USA

ABSTRACT

Keepers at Disney's Animal Kingdom® investigated a variety of ways to observe and document animal behaviors and interactions. They wanted a streamlined method that would eliminate bulky cameras, wires and attachments. Ideally, the equipment should be small, compact, wireless and weatherproof (if possible). Through internet searches and contacts with zoo colleagues and after trying multiple cameras, it was decided that a "GoPro®" camera would be the best option. The GoPro® allowed keepers to quickly and easily do the following: check on eggs and chicks in a Hammerkop (*Scopus umbretta*) nest; watch for aggression and shifting between large flying foxes (*Pteropus Vampyrus*); see the trainer's point of view with tiger (*Pantera tigris*) training; record and track progress of Komodo dragon (*Varanus komodoensis*) training sessions; and watch how a lesser Madagascar hedgehog tenrec (*Echinops telfairi*) behaved at night (when they are the most active). The GoPro® has been a great additional tool for keepers. Using it has allowed keepers to minimize stress to the animals, improve exhibits, and catch problems early. Overall it helps us make sure we are giving our animals the best care possible. The GoPro® also helps keepers to tell their story and share their passion for their animals in a new and exciting way. We plan to find new opportunities for using our GoPro® that will continue to improve the quality of animals' lives and enhance our guest's animal appreciation.

INTRODUCTION

Keepers on the Trails team at Disney's Animal Kingdom® needed an easier option to observe animal behavior. Since only a bulky camera was available, several other options were investigated. The team finally settled on a GoPro®, which is a small, lightweight, waterproof durable camera. These cameras can capture both high definition pictures and video with minimal impact to the animals. Due to their size and ability to be mounted to almost anything, these cameras make great options to capture pictures or videos of skittish animals that would not normally be observed. Since they can be connected to most smart devices over Wi-Fi, keepers can remotely observe and then decide exactly when to take a photo or video. They have a wide array of uses from observing training and enrichment to determining what the animals are doing when there are no keepers around. The goal is of course improving the quality of animal's lives.

METHODS

The first example is 1.1 Hammerkop (*Scopus umbretta*) built a nest in a tree located over the water inside the Africa Aviary on the Pangani Forest Exploration Trail. This location presented several observational challenges due to the height of the nest and being over water. Previously,

an aging FieldCam system was used to check the nest. That system required a plug-in power source as the battery would no longer hold a charge. It also would no longer record what the camera was capturing. Both of these challenges increased setup time and number of keepers needed. The whole process was very stressful for the Hammerkops as the birds would see the extension pole and keepers coming towards their nest and they would start to fly around and vocalize. Keepers wanted a more efficient way to check their nest to reduce stress and time. When our new GoPro® arrived, keepers were able to attach the camera to the pole in an area not visible to the Hammerkop. Keepers could quickly walk out to the nest with the camera already attached, raise the pole up into the nest, then lower the camera and walk away in a very short period of time. This reduced the amount of time the birds were stressed and it lessened the time constraints on keepers as just one or two keepers could check nests. The GoPro has the added benefit of having a Wi-Fi connection. This allowed keepers with any smart device to see what is happening. As the picture is being looked at, a recording can be stopped or started and modes can be switched from video to picture. Since guests are always curious as to what keepers were doing, this was one way to show live and recorded video to them. The definition of the photos and video captured by the GoPro® have allowed keepers to closely inspect eggs. Not only can eggs be closely inspected but since chicks stay in the nest for long periods of time, it also allows the developmental progress of the chicks to be monitored.

The second example is: 13.0 large flying foxes (*Pteropus vampyrus*) and 3.0 Rodrigues fruit bats (*Pteropus rodricensis*) call the bat exhibit on the Maharajah Jungle Trek home. In non-summer months these bats start lining up near the closed doors that lead to their off-show holding area and food. This led to the more dominant bats guarding the doors and picking fights with any other bat that came near. Sometimes these fights led to a bat falling to the exhibit floor, which could result in injury to a bat or be able to climb his way back up. If a bat was able to climb back up, this increased to risk of more fights and potentially more falls. This situation was an ongoing cycle so keepers wanted to know if the bats were cueing into something that made them line up. Since keepers cleaned the exhibit in the afternoon, the thought was maybe they were cueing off of that. Keepers decided to place a GoPro® near those closed doors looking out into the exhibit to see what was happening. The camera was placed in the exhibit for several days with nothing else changing. It was also placed in their exhibit for a few more days when the exhibit cleaning time was changed. These recordings led to team discussions to figure out how to better manage the bats so that the fighting and falling would be minimized.

The third example is involved a new male Komodo. After he had been acclimated to the barn for a few days, staff began the process of training him to shift from his stall, through an outdoor chute and onto his exhibit. A GoPro® was placed outside the mesh recording the entire training session. After each session, the footage was reviewed and critiqued so that the trainers could make sure that all of their cues were as consistent as possible. This consistency allowed for the Komodo dragon to quickly learn the cue and shift onto his exhibit.

Finally, the Research Center on the Pangani Forest Exploration Trail is home to 1.1 lesser Madagascar hedgehog tenrec (*Echinops telfairi*). Due to the nocturnal nature of these animals, keepers needed to understand what was happening at night. The GoPro® recorded their behaviors on more than one occasion to try to answer several questions such as: are both tenrecs eating only their own diet? Are they using their enrichment? And are there any breeding behaviors happening and how active are both tenrecs during the evening?

RESULTS

First, after the Hammerkop nest was checked with the GoPro®, it was determined that 10 eggs were in their nest. The team was able to quickly meet and discuss with zoological managers the next steps that needed to be taken. It was determined that eight of the eggs would be pulled and replaced with dummy eggs. The nest was checked again about a week later to determine how the remaining eggs were progressing. At this time it was discovered that both eggs had hatched and there were two chicks. After this, the nest was monitored on a weekly basis with minimal disruption to both the parents and chicks inside the nest.

Second, the GoPro® was set up for multiple days under multiple weather conditions inside the bat exhibit; it appeared that the bats started to line up after the keeper had come out in the middle of the afternoon to clean their exhibit. Once the keeper had cleaned their exhibit and left, the bats lined up presumably in preparation to come inside. Keepers were also able to identify which bats came inside first. The first bat or two that came to the doors seemed to be the ones who started most of the aggression.

Third, since every keeper was shown how to train the Komodo dragon by reviewing the video, the shifting behavior was captured quickly and allowed the guests to be able to see this new komodo in his exhibit.

Finally, the GoPro® allowed keepers to watch the tenrecs and determine that the female was eating her entire diet plus some of the male's. It also allowed keepers to figure out which enrichment the tenrecs use and prefer and which ones they did not interact with. It allowed breeding behaviors to be observed with no interference. It also showed that the male tenrec was more active at night than the female tenrec.

DISCUSSION

The GoPro® has been a great benefit to keepers. Many questions they had about their animals have been answered thanks to the GoPro®. It has solved some problems and reduced the amount of time that our animals could be in a stressful situation. Not only has the impact been felt by our animals but the impact has also been felt by our guests. Since our guests are always inquisitive, this allows keepers to give them first hand perspective of what the animals are doing. Since there may not always be an animal or nest available for them to see, recorded video can also be shown as a guide for the guests.

CONCLUSION

In conclusion, the GoPro® has been a great additional piece of technology. It has allowed keepers to enhance their animal care by controlling food intake, reducing stress, preventing injury and making easy acclimations to new exhibits. Keepers can also now share their story and their passion in a unique way that allows the guests to get closer to the animals than ever before. Since these were just initial trials for the GoPro®, several additional uses for the GoPro® have been discussed that will continue to improve the quality of animals lives and enhance our guest's animal appreciation.

Animal Care Continuing Education Series for Success

By Brian Williams, Animal Keeper

Disney's Animal Kingdom

Orlando, Florida

The A.C.C.E.S.S. program (Animal Care Continuing Education Series for Success) at Disney's Animal Kingdom creates a platform where individuals can present their expertise on topics related to the animal care field. While this is not an entirely new concept, it is an area that can be overlooked as you fail to appreciate the expertise present amongst your own staff. Programs like this not only provide an efficient and cost effective means to educate staff, but also create a forum for staff to develop public speaking and leadership skills. The experience and knowledge of an institution's staff is a valuable resource that should be used to its fullest potential.

As with all initiatives at the zoo, leadership support is essential to success. Leaders must support the time and logistical needs associated with holding a regular continuing education series. At the same time, leaders should understand that this type of program is a win for everyone. Organizers win by learning new leadership and communication skills. Speakers/presenters win by learning presentation and public speaking skills and by feeling empowered and appreciated for their expertise. Attendees win by gaining new knowledge and skillsets valuable in the zoo profession. The institution itself wins by employing a staff that continues to grow and improve in their profession.

Once you have leadership support, the first thing you need to do to create a program like this is to find topics and presenters. Focus on the expertise of staff at all levels of the zoo, from keepers to leads/mangers to senior leaders. We found great success in broadening our topics to include not only animal care, but also leadership based topics. A schedule was developed to coordinate the presenter's availability with the most effective times and available locations for attendance. We like to plan six months ahead to insure locations and preparation time for the presenters. We found we could accommodate one topic presented each month. They are given twice during the presenter's work week to allow for attendee's varying days off. The presentations are scheduled around or after lunch and last approximately forty five minutes with time for questions and discussions. An email to everyone two weeks before the presentation with a reminder the week of has worked well for us. After the presentation, we provide the PowerPoints online for any employee unable to attend, but another option we have discussed was to record the presentations.

Topics in the A.C.C.E.S.S. series have been very specific and very broad. They have included "Understanding TAGs and SSPs", "Hand rearing hoof stock", and several animal training presentations. Senior leaders have provided presentations on their background and professional career path to get to know them better. The veterinary staff has given presentations on cancer, renal failure in large cats, and chemical restraint in large herbivores. We have also had presentations on water quality systems, exhibit projects, and animal acquisitions. Many of these presentations have been given at different conferences. The ability to do these in house has given staff the chance to practice their presentations and pass along

their knowledge to co-workers unable to attend the conferences where the presentations are normally given. The best thing about the program is the flexibility to make it whatever you want. This could be set up through your institution or an organization like your local AAZK chapter.

In closing, I would just like to reiterate the low cost and high benefit of a program like this. The logistics of developing and maintaining this program were daunting at the start, but have become easier if not routine with time. It gives a great learning opportunity to new and experienced keepers alike. There have also been development opportunities for those of us who run this program. I have personally strengthened my organizational, networking, and public speaking skills. This program has evolved into an avenue to recognize co-workers and provide professional growth to everyone involved.

Training Nile Hippopotamus for Voluntary Blood Draw

Mark Hacker, Senior Biologist
Adventure Aquarium
Camden, NJ

Introduction

Adventure Aquarium currently houses 0.2 Nile Hippopotamus (*Hippopotamus amphibious*) in the Hippo Haven exhibit. Training is one of the most important components of our animal husbandry program. They are trained for a variety of different behaviors including open mouth, head up, back up, lie down and hold. The most challenging behavior that we have attempted is a voluntary blood draw using our Hippo Restraint Chute (HRC). The trainers often perform many voluntary medical and husbandry behaviors with their animals in order to decrease stress levels. We wanted to be able to collect a sample of blood in order to run a standard chemistry panel but also analyze hormone levels. This would help us monitor their health and possibly observe estrus cycles. Different behavior patterns have been observed between the two hippos and we feel that analyzing hormone levels may offer an explanation or even an answer to these observations. After experimenting with different collection sites for 7 years and upon further discussion with training staff and our veterinarian we identified the tail as a potential location for a blood draw. Due to the fact that our hippo must enter the HRC to go out onto exhibit, we had a great head start in working toward a completed behavior. We began to desense the hippos to the closing of the rear door, all the while keeping them focused on the training session. One of the most important steps of the behavior was to be able to position the animal to provide safe access to the tail for the veterinarian to draw blood. We experimented with different tail positions and needle angles resulting in a successful voluntary blood draw from the side of the tail of one of our hippos. This paper will describe how the trainers at Adventure Aquarium were able to successfully train this behavior by using operant conditioning and desensitization.

Methods

One of the most important and beneficial steps towards achieving our goal of a voluntary blood draw from one of our Nile Hippos was already completed prior to starting this behavior. In order to be released onto exhibit, the hippos must pass through our HRC, which we commonly refer to as our "Hippo Hugger." (See Figure #1) They also must pass through the chute to return to hippo holding. This was something they had been doing for over three years prior to the start of the voluntary blood draw training process. Another positive step that had already been accomplished came in the form of a previously trained behavior: voluntary weight on scale. The hippo would be brought into the chute with the front gate closed. There is a space created using interchangeable bars that allows for the animal to bring its head fully through the front gate thus centering the animal on the scale. A trainer stands in front of the gate providing primary reinforcement after the hippo remains still and an accurate reading is taken. Then the trainer gives the cue to "back up." Once the hippo backs out of the chute, the back gate is closed and they are rewarded again. During this behavior, the back door would remain open. For the voluntary blood draw, the back gate of the chute would need to be closed. This gate can be closed once the hippo has entered the chute and has moved up far enough for the gate to clear the animal. Desensitizing the hippos to closing the gate required patience and time. Each time we would weigh the hippos we would close the door slightly. One trainer would operate the hydraulic shift door while the other reinforced the hippo with monkey chow (Mazuri Primate Browse Biscuit). Over a period of about a month (hippos are weighed once a week) we were able to close the door on one of our hippos without a reaction response. This particular hippo is more reliable and has a higher tolerance threshold when it comes to new training situations. Our success rate with her voluntarily entering the chute and tolerating the back gate being

closed was high. An unsuccessful session included the following: biting the front gate, backing up, lifting her head up high, and sitting down in the chute. Positive sessions included: calm demeanor and cooperation for basic behaviors such as open mouth, hold and target. By conditioning the hippos to be comfortable with closing the rear door and remaining focused on the training session to allow for the trainer to position the animal, the veterinarian had safe access to the tail (See Figure #2). Up to this point in our training, we have not manipulated the squeeze doors in order to restrain the animal in our HRC. During our sessions we were able to witness precursors that could have led to an unsuccessful session in some cases. We observed forward movement, attempts to sit down in the chute, as well as biting at the front gate. About 90% of the time we were able to work through the session by either waiting for her to refocus or by giving her an LRS. During this time, the veterinarian would not manipulate the tail or the needle until she was calm and back in position. The hippo would be released from the chute upon any sign of stress or frustration that did not quickly subside. Up to this point in our training, we have not manipulated the squeeze doors in order to restrain the animal in our HRC. We continue to work with one of the hippos to this day on the desensitization process of closing the back gate to the HRC.

Once we had established the fact that one of our hippos would tolerate being in the chute, we had to increase the length of time she would be kept in the chute. We found that as long as we continued to reward with food items ranging from monkey chow biscuits to whole honeydew melons, we had plenty of time to work with. Although we have often used tactiles as a way to calm our hippos when in the restraint chute during weight sessions or as they are released onto exhibit, we knew that the tail was going to be a sensitive area. We approached tail desense in the same way and used a verbal cue "touch" before touching the area around her tail. In a short period of time we were able to actually touch her tail for short periods of time. In the beginning and to this day, there is almost always an initial reaction in to form of tail twitching or swishing. Even during the actual blood draw session there are still slight reactions to the tail being touched or poked. We added a second verbal cue "spraying" which we used to simulate the spraying of an alcohol solution at the stick site. A water bottle was used in the beginning before changing over to an alcohol solution.

Our original training plan was to draw blood from the vein underneath the tail bone by physically holding up the tail. This is a method used by some veterinarians when drawing blood from cattle. We soon realized that the hippo would not tolerate us holding up her tail for an extended period of time or even enough to desensitize to a needle stick. After consulting with our veterinarian, he decided that it would be best to try a lateral approach to the tail. We began by using a pen cap and a verbal cue "sticking" to desensitize the needle stick. There was an initial twitch response from the first stick and a few more after. Once we didn't see a reaction, we held the pen cap in place and applied a small amount of pressure. After a short period of using the pen cap, we decided to move on to using a 21 gauge needle. We also started to touch the hippo on the flank area prior to the stick. When using the needle, we would not penetrate the skin more than a quarter of an inch during the desense process.

Each time we would work with the hippo in the chute, we would reinforce her behavior with food items such as monkey chow, greens, carrots, melon, or apples. When we initially bring the hippo into the chute we reward them from the front of the chute. Once they are completely in the chute and the door is closed, we begin to reward them from the side. If we stand on the side, the animal must back up in the chute which places her in the perfect position for the veterinarian to safely collect the blood sample (See Figure #1). Before beginning the stick, we would wait for the hippos head to be up. The trainer would reward with food items slowly to keep her head up as long as possible. Once she would drop her head to chew, her whole body position would change and make it more difficult to collect the sample. When she would bring her head up again, her body would be back in position to continue with the blood draw attempt. Our veterinarian was also brought in on several training sessions so that the hippo would become desensitized to his presence as well. We found that there was some reaction in the form of reactiveness in the chute when our veterinarian was present versus a trainer's only session. We would encounter a few

behavioral issues due to possible estrus cycle, environmental distractions or other unknown reasons. There was a lot of tail swishing and moving forward during the initial stick. At times the hippo would also sit down in the chute and refuse to offer her tail at which point the session would be ended and she would be backed out of the chute. A variety of needles were used before choosing an 18 gauge, 3 ½ inch needle. The needle is inserted laterally slightly below the base of the tail. Upon finding the bone, the needle is redirected until a vein is reached. The syringe attached to a butterfly allows us to collect an adequate blood sample which can range from 1 mL to 5 mL depending on the success rate (See Figure #3). Once the needle is removed from the tail, the animal is given the verbal cue "back up." Upon backing out of the chute, the hippo would be jackpotted with some of her favorite treats.

Conclusion

At Adventure Aquarium training principles are used that increases the well-being of our animals which includes cooperation for both husbandry and medical procedures. In the case of our voluntary blood draw behavior we were able to successfully combine these two principles using operant conditioning and desensitization. The technique we used had been developed, amended, and refined over a period of close to ten years. We have found that there are many advantages to training for veterinary purposes. It decreases stress during procedures and decreases the amount of time needed to collect samples. There is less stress on staff as well. An immobilization procedure to collect blood on a hippo is a risky procedure and would involve using a large team of accomplished and trained staff. You also never know how an animal is going to react under an immobilizing agent. A voluntary blood draw where the animal is relaxed the entire time can also give you a more accurate reading of the sample. The lower the stress results in a better test. Training for veterinary procedures is also a great way to further develop the bond you have with the animals you work with and treat. It also is an opportunity for the veterinarian to improve his or her relationship as well. There are many reasons that the information we gather from our voluntary blood collections will be beneficial. It will help us understand our hippos as individuals and recognize certain things about their behavior based on those blood values. Other institutions that have hippos in their collection will be able to compare data as well. Hormone levels can tell us a lot about our animals and how we can better manage them under our care. We are currently working on the desensitization process with our second hippo as she is more apprehensive about being in the HRC for extended periods of time and with the back gate closed. In the future we would like to compare hormone levels for both of our hippos using both blood and fecal samples. For now, we continue to refine our technique and work towards collecting samples on a regular basis in an effort to create a baseline hormone level for our Nile Hippopotamus.

Figure #1

Figure #2

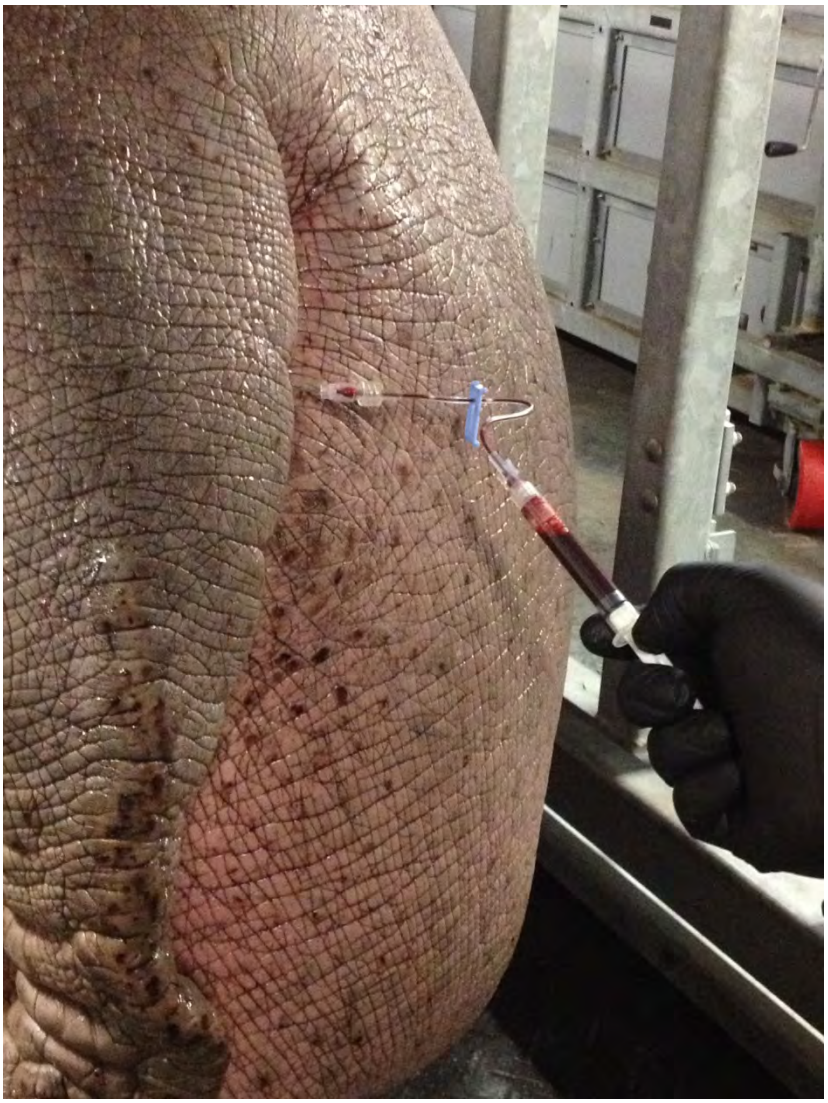


Figure #3

Evolution of the Hog Chute

By
Christina Eastwood, North Savanna Mammal Keeper II
Dallas Zoo
Dallas, Texas

Abstract
Training an injection behavior with hogs can be challenging for multiple reasons. The animals naturally want to face the trainer and do not like to bring their sides to the fence line while standing. At the Dallas Zoo, we have gone through multiple devices and designs to aid our hogs in leaning against the fence line. All of these designs have created an easier and safer way to train medical and husbandry behaviors. As the designs progressed through the years, we were able to accomplish more training goals. The current design has an adjustable wall so the hog can line up along the fence depending on the animal's size. The chute is also collapsible and can be stored against the fence when not in use. Training successes in the chute include hand injection for vaccinations and immobilization agents, blood draws, and ultrasounds. We have also begun work on hoof trim training. Through the years, we have seen many different chute possibilities that can work for all different training goals and budget sizes. The current design provides the most flexibility and success to Dallas Zoo's hog training program.

Introduction

Every keeper strives to find ways to reduce animal stress levels to perform husbandry tasks and medical procedures. Commercially manufactured squeeze chutes and restraint devices have been developed for some species to accomplish these tasks. Depending on a facility's needs and budget, these devices may not always be the best option. When deciding to start training two swine species, *Phacochoerus africanus* (Warthog) and *Potamochoerus porcus* (Red River Hog), how to take a voluntary hand injection at the Dallas Zoo, we started brainstorming different methods.

Because they are a prey species, hogs can make injection training difficult. They are constantly listening to their environment. They naturally move their bodies in a manner to face the trainer which makes it difficult to have them line up along the fence line. We tried multiple tactics and chute designs to assist them with lining up along the fence line. Each design became more complex as items were added and changed through the years. Each design suits a specific goal and budget size that can work for any animal facility.

Basic Design

The first design started simply, and was installed in the zoo's 1960's era hoofed stock exhibit. In order to encourage the hogs to line up along the fence line, a log was secured into the ground with rebar, and the log was aligned parallel to the fence. The log was buried with the top half sticking up out of the ground approximately 30cm. This design created a guide so the hogs had to walk parallel to the fence for training sessions. To allow access to the hogs, a portion of the chain link fence was cut out by keeper staff and replaced with horizontal square tubing by the zoo's welder (L. Fitzgerald, personal communication, March 16, 2015).

The behavior successes that were achieved, included: lie down, foot/belly, tactile, sit, blood draw, and hand injection. A few problems that were noticed, included: parts of the hog were too far to reach safely, the female was never comfortable with lying down or needles, and the hogs lifted the log out of the ground occasionally and could step over the log easily. Since the log was

affixed in the ground, it could not be adjusted to fit different body sizes. The cost of materials for this project were very minimal and just required some labor from a keeper and welder.

More Accessibility

A new facility was built for the hogs when the Giants of the Savanna exhibit opened in 2010. The barn was built of mesh and chain link barriers between the keepers and hogs and we needed some new training strategies. The barn needed greater accessibility to make certain training behaviors possible. The hogs would line up along the fence line, but only certain objects could make it through the chain link to make contact with the hogs. Even injection behaviors were difficult because the hog barely had to move and the syringe would hit the side of the fence. A large area was cut out of the fence and new metal bars and panels were put in place. Three metal bars were installed horizontally and spaced to create two holes. Then four flat metal pieces were installed vertically (one on each end and two equally spaced in the middle) to create six holes total. These flat pieces were also installed to create a gap between them and the horizontal bars. With this gap, we were able to create the panels (See Figure 1). These full-size panels could slide upward and downward to open or block the holes. When a panel was pulled upward, it could be clipped to the fence to either open one or two holes (See Figure 2). The first panels used were clear Plexiglas® so the trainer could see the hog's entire body while working with them.

With this new accessibility, we were able to decide which holes should be opened to perform the training task needed, while having other holes covered to keep the trainer safe. Certain holes were for accessing the belly and hips. This opened up possibilities to ultrasounds, injections, and applying topical treatments. Some challenges that were experienced were that with no back wall, the hogs could still move away from the trainer. The hogs could also not have access to the area without being monitored because the Plexiglas® ® was not believed to be a durable enough product for long term exposure. The cost of materials were for the metal bars and a day of labor for the welder to prepare and install the items.

Figure 1 - This shows the six spaces that were created with the Plexiglas® panels in place to close off the openings.

Figure 2 - This shows two of the Plexiglas® panels slid upward and clipped in place to expose different openings. In this picture, the left bottom hole is where the hog would be fed. The top right opening is where the hip would be exposed to perform different behaviors.

Squeeze Chute

A lot of extra features where added in the third design, including a removable chute and an adjustable wall. Due to a limited budget, the entire design was made out of wood and High Density Polyethylene (HDPE) and was built entirely by keeper staff. When we had two warthog piglets, it became very evident that an adjustable wall would be very handy since they would grow over time. This design was built in the barn on a concrete floor with limited space. Every spot in the barn was used for housing hogs overnight and in inclement weather, so it was important that the chute did not take up much space. Because of this fact, we decided to make it moveable. The base of the chute had six wheels with a wooden frame and an HDPE floor (See Figure 3). A mat was bolted on top of the base to create a non-slip surface. To create the adjustable wall, four wood pieces (3.81cm x 8.89cm) were attached in the corners in an upright manner with a larger wood piece (3.81cm x 19.05cm) across the top going from the front to the back of the chute. Then two small wood pieces (3.81cm x 3.81cm) were installed between those two for stability (See Figures 4 and 5). These top large wood pieces and the base had a notched pattern that allowed the wall to be moved forward or backward and then locked in place (See Figure 6). The movable wall was made of HDPE with four bolts wedged between two pieces in each corner. These bolts fit in the notched out areas to guide the wall into place. The

chute was then bolted to the metal frame of the fence line. These bolts made the chute removable from the wall so it could be stored in another area when not in use. The chute was placed far enough away from other walls that the hog could have a round-a-bout. This gave the animal the option to enter the chute from two directions and provided us with opportunities to access both sides of the body. Doors were not added to the design so the hogs could choose whether or not they wanted to participate in a training session.

Along with the fence panels from the previous design, this chute enabled us to train a lot of new behaviors. The adjustable panel made training a more gradual process for the individual. The chute could be made very wide when they first learned to step in the space, then made increasingly more narrow as the animal became comfortable. The HDPE wall made it easy to clean and disinfect. The frame was made of wood due to cost and weight. Wood is durable enough to handle the weight of the hogs but not as expensive as metal. The wood was treated with a water sealer to slow down the decay.

This design allowed trainers to accomplish ultrasounds, injections, and blood draw behaviors. The full-sized wall was not only helpful in lining the hog along the fence line, but it helped ensure the safety of the trainers while performing these tasks. The hogs were not capable of turning around in the chute and had to walk forward or backward to leave the area. This made it less likely for a trainer to get injured from an animal bite if they tried to turn. A few challenges, included: the chute had to be moved every time a training session occurred, the HDPE wall had to be pre-set before the hog had access to the area, the hogs could still not have access to the area overnight, some chewing was seen when the hogs lost focus in a session, and the wood would rot over time (even with the water sealant). The materials for this design are reasonably priced and can be found at any hardware store and was built entirely by keeper staff.

Figure 3 - This shows the base of the chute with the layers of the wood frame, HDPE, and the rubber mat on top. There were six wheels spaced out along the bottom for mobility.

Figure 4 - This is the front view of the chute where the trainer would be during the session.

Figure 5 - This is a side view of the chute where the hog would enter.

Figure 6 - This is a top view of the notches that allowed the back wall to move forward and backward and lock in place.

Current Design

The current design makes the squeeze chute extremely durable, collapsible, and keeper friendly. The framework for this design is all metal and the squeeze wall is HDPE. With these materials, we do not have to worry about the product getting weaker over time and it makes it very easy to clean and disinfect every part of the device. The chute is collapsible so the device is always in place but can be folded down to only take up 8.89 cm of space in the animal's area (See Figure 7). This frees up storage space for the chute in the barn and allows hogs to be in the space overnight without concern over damages or injury. The chute has two "C" shaped bars going through guides in the fence where they are attached to the HDPE wall. The wall has two wheels on it so the wall can be moved forward and backward. The "C" shaped bars have holes drilled through the top and bottom bars, along with the fence guides so the squeeze wall can be pinned in place at the desired width (See Figures 8, 9, and 10). There are four hinges on the "C" bars, one at each top and bottom. When not in use, the squeeze wall can be moved all the way up against the fence line and the two "C" bars can be folded towards each other due to these hinges (See Figure 11). The "C" bars are then pinned to each other so the bars do not open up and the squeeze chute cannot be moved by the animal on the other side (See Figure 12 and 13). The panels to access the holes were changed to a metal mesh material. There is still just as much visibility as the clear Plexiglas® , but they are more durable and can be used as an extra barrier with piglets while still being able to feed or access them. Three more access holes were also created to access feet. The new foot openings added the trainer's ability to do foot care (See Figure 14). This design also lacked doors to enclose the animal into the space. This was chosen so that the animal will always have the option to leave if they are uncomfortable with the situation. Hogs are very good jumpers, especially in stressful situations, so enclosing them can lead to them trying to jump over the wall when uncomfortable. The

bottom of the "C" bars are far enough off the ground that our scale platform will now fit in the space. The hogs always had a hard time keeping all four feet on the scale platform due to the width. The chute guides them to keep all four feet in place to receive an accurate reading. It also deters the hogs from moving and damaging the scale like they did in the open (See Figures 15 and 16).

We have seen a lot of training success with this new, versatile chute, including: injection, ultrasound, blood draw, hoof work, radiographs, applying topical treatments, lying down, physical exams, and weighing (See Figure 17). We have experienced very few challenges so far. The two bars at floor level can get in the way sometimes when trying to get the hog in certain positions (especially lying down on the floor). Sometimes food will find its way under the bar out of reach from the hog which pulls the hog's focus from the training session to extract the food item. The bars also get stuck in the guides occasionally and must be greased often. The materials for this design mainly consist of metal bars, mesh, and HDPE. The zoo's welders did all the building work which took about three days for preparing the materials and installing the design.

Figure 7 - This is a side view of the chute closed with the panel pulled against the wall.

Figure 8 - This is a side view of the chute open and pinned at a width that is ideal for most of our female hogs in a standing position.

Figure 9 - Front view of the chute with the "C" bars on each side, opened for a training session. This is the area the trainer will stand during a session.

Figure 10 - The top view of the chute shows the holes in the "C" bars on the top and bottom that are pinned to position the wall at different widths.

Figure 11 - A top/side view to show how condensed the chute is when it is closed and not in use. The hinges used in the design are also seen.

Figure 12 - A front view of the chute in the closed position when not in use.

Figure 13 - A top view of the two "C" bars pinned together when closed so the hogs cannot move the chute from the other side of the enclosure.

Figure 14 - This shows the new bottom openings that were created and all the different possible openings that can be exposed for husbandry or medical needs. The left bottom opening is to access feet. The middle opening is to access the belly. The right top is to access the hips.

Figure 15 - A front view of the chute with the scale in place.

Figure 16 - A side view of the chute with the scale in place. The scale slides right under the bottom "C" bars.

Figure 17 - A hand injection training session with 0.1 Warthog, "Marge."

Conclusion

No matter what your goal or budget, there is a training device that will suit your needs. These are the different designs we went through at the Dallas Zoo. We started with a temporary, basic design and kept adding features until we ended up with a design that met all of our needs. We have now successfully given hand injected vaccinations and immobilization agents to 1.1 Red River Hogs, while 0.2 Warthogs are still making progress with injection training. A blood draw has been performed on 1.0 Warthog and is in progress with 1.1 Red River Hogs. Ultrasounds have been performed on 0.1 Warthog and 0.1 Red River Hog to detect pregnancy. Cocoa butter is applied to all Warthog's hind quarters in the winter time to condition their skin. Foot work is in progress for our 1.0 Red River Hog to reduce having to immobilize him for bi-annual foot trims. We are very excited about the doors that have been opened up with this chute design and the many behaviors that we can train the hogs. This chute has allowed many husbandry and medical behaviors to be performed with limited or no stress.

Acknowledgements

I would like to thank the building maintenance staff, especially Randy Leewright and Billy Lawson, for their assistance with the design of the final chute and building our dream. Without your welding skills, this amazing design would have never come to life. Thank you to Tanya Barton-Garcia and the rest of the North Savanna team for support with design ideas and training. Thank you to all the former Warthog and Red River Hog trainers, including Sara Squires and Brandon Lenenski, for their efforts and ideas to progress training at the Dallas Zoo. Lastly, I would like to give a special thanks to the Dallas Zoo for its continued support and allowing me to attend the conference to present this paper.

References

Eastwood, C., 2015. Figure 1-17. [photograph] (private collection).

Products Mentioned

Plexiglas®. Arkema France. 420 Rue d'Estienne d'Orves, 92700 Colombes, France. www.arkema.com

The Raven "Nevermore": Challenges in training an extremely sensitive raven.

By

Jennifer Walsh, Assistant Manager of Behavioral Management and Education

National Aviary

Pittsburgh, PA

Abstract

Crows and Ravens are the most intelligent birds in the bird world. They can make excellent birds for educational programs because of their ability to learn various behaviors very quickly. However there are several challenges that can come along in training such an intelligent species. This paper will discuss the challenges trainers at the National Aviary faced when training a 0.1 White-necked Raven for several different behaviors including color discrimination and collecting donations from visitors. These challenges included sensitivity to changes, innate scavenging instincts, fear of certain objects, and constant changes in environmental factors. Trainers overcame each obstacle in different ways using positive reinforcement training, desensitization, habituation, patience, and re-evaluation of behavior criteria. Through her training, the National Aviary's White-necked Raven has since been able to gain enough confidence to be used for a media promotion. Crows and Ravens can make great program birds but there can be challenges when overcoming their inherent sensitivity. There are ways to work through these challenges that also provide valuable lessons to trainers who can apply them when training new behaviors in the future.

Introduction

Birds in the family Corvidae, or Corvids, are considered to be the most intelligent birds in the world. This family contains birds commonly known as crows, ravens, rooks, jackdaws, jays, magpies, treepies, choughs, and nutcrackers. These birds have demonstrated a natural ability to cache, or hide food for later which requires a certain level of cognition because food is not always readily available. On top of that they also have exceptional memories with their ability to remember where their food had been cached. Crows and Ravens are omnivorous, opportunistic, and are inherently great scavengers. Some scientists have credited these birds with great intelligence due to research that has discovered New Caledonian crow's (*Corvus moneduloides)* use of tools to solve problems (Weir et al, 2006). Others have found that crows have an ability to recognize human faces (Marzloff et all, 2012). Due to their intelligence Corvids can make excellent birds for educational programs because of their ability to learn various behaviors very quickly. The goal of this paper is to discuss the training of a 0.1 White-necked Raven (*Corvus albicollis)* named "Ginnie" for several different behaviors and the challenges that can come along in training such an intelligent species.

Materials and Methods

In July 2010 the National Aviary acquired a 0.1 White- necked Raven name "Ginnie" to incorporate into educational programing. The bird arrived with no known training history; however she arrived wearing anklets and jesses which staff immediately cut off upon arrival. It is policy not to use equipment on birds other than true raptors, defined as birds that hunt and kill with their feet. During initial quarantine, trainers noticed that "Ginnie" would frantically fly around her enclosure when staff entered the room or when changes were made to her environment, including additions of environmental enrichment. Due to

pre-established sensitivities staff decided that training would begin after the bird had time to acclimate to education trainers. After being housed with the education collection under the care of education trainers, basic husbandry training began. A primary and secondary trainer were established for consistency with training. Using positive reinforcement training the raven was initially trained to come down to a scale daily for weights and then trained to go in and out of a crate. Education trainers with previous experience training more challenging behaviors were assigned to train this specific raven. Bridge timing would be crucial when training such an intelligent species. Because of their ability to learn very quickly, Corvids have been known to pick up superstitious behaviors if trainers are not careful about what is being bridged and reinforced therefore experienced were necessary.

Challenge: Changing Environment

Due to the nature of public educational programing at the National Aviary, which includes an indoor theater setting, a bird's environment can be subject to frequent and uncontrollable changes. For example, the number of people sitting in the seats from day to day, changes in set lighting, and sound and music changes throughout a program. Birds that are included in free flight shows have learned to adapt to these ongoing changes. The initial training plan for "Ginnie" involved desensitizing her to various classrooms and theater sets as well as to unfamiliar people "strangers" watching her training sessions. Desensitization is exposing an animal to a stimulus using time or experience to drive the stimulus value toward neutral. A process of changing an animal's perception of an event, negative or positive, but usually negative, to a neutral perception as evidence by the animals lack of response to the event when compared to a previous baseline (Ramirez, 1999). In order to do this trainers would ask "Ginnie" to crate and take her to a variety of new spaces while reinforcing her for calm behavior, or ask her to simply to come out of the crate and go back in. Once the raven was comfortable with new spaces, trainers started to incorporate different types and numbers of people into watching her training sessions.

Challenge: Natural Foragers

One on-going challenge that presented itself through out several training sessions was "Ginnie's" naturally opportunistic nature. As scavengers they are prone to foraging and scavenging to find food. When trying to train a new behavior "Ginnie" would occasionally try to find food that may have been dropped on the floor. Since spaces used to train "Ginnie" were also used to work other birds there would occasionally be food on the floor for her to discover which was not advantageous to her training. To overcome this, trainers would have to be very proactive in setting up the training session environment. The floor was checked and swept for pieces of food. The trainers would have to wait patiently until the raven was finished making sure there were no easy scraps for her to get before participating in her session. Often a time out was used to discourage foraging, the trainers would re-crate "Ginnie" for only a small piece of reinforcement and leave the room for a period of time, taking away her opportunity to earn additional reinforcement.

Donation Box Behavior

After initial desensitization training to new environments, staff decided that a donation box behavior should be the next thing trained as it will allow "Ginnie" to participate in educational shows. The donation box behavior is performed immediately after free-flight shows and requires "Ginnie" to take a paper money from a visitors hand while stationed on a box, and then stick that donation in the box. Since this behavior is performed after the show, it would not affect the progression of the show. It would also allow for her to gain confidence with visitors by "Ginnie" taking donations from a guests' hand, putting the donation into the box, thus earning her reinforcement. However it also gave her the choice to fly

backstage if she felt uncomfortable, giving her power over her environment. After training her to stuff paper money into the donation box, trainers started incorporating unfamiliar staff members and then eventually guests into training sessions until she was ready for shows.

Challenge: Fear of Wheel Chairs

Once "Ginnie" started doing shows regularly trainers started to notice that she became very nervous and would fly off her box to backstage areas when wheel chairs approached. It was determined that "Ginnie" had a very established fear of wheels chairs which generalized to strollers and things that moved on wheels. Trainers however were not sure when or how this fear developed. Trainers decided to work on the raven's fear of wheel chairs as it is something that she could encounter on a regular basis during educational programming. Trainers elected to start training desensitization to wheel chairs while the raven was inside her enclosure where she is most comfortable. Desensitizing inside near her enclosure would also prevent her from getting into a habit of flying away from the wheel chair and getting reinforcement for coming back. A wheel chair was left outside of the "Ginnie's" enclosure for a period of time, a type of desensitization called habituation. Habituation is the process of exposing the animal to the aversive stimulus by placing and leaving it near the animal's environment but allows the animal to escape if it chooses. When "Ginnie" was acting calm in her enclosure in the presence of the wheel chair, trainers started feeding her closer and closer to it. Eventually the wheel chair was left inside the enclosure during the day while staff was on site. The next step was getting her comfortable with a person sitting in the chair. Trainers would go in and feed her for coming close to them while they sat in the chair. Then trainers would try to shift or move the chair slightly and reinforce the raven for calm behavior. Trainers had to be careful not to reinforce the fear response to the wheelchair so the raven wouldn't learn that by acting fearfully, she would earn reinforcement. Once she was acting confidently inside her enclosure we moved the wheel chair back to in front of the money box. Trainers were able to establish a behavior where she would take the dollar from a person sitting in a still chair however she would not stay on the moneybox when the wheel chair approached. Trainers began to consider if "Ginnie" was the right bird for this job, maybe she would be able to do a different behavior in which approaching wheel chairs would not be an issue. Training a new show behavior in which wheel chairs might be present in the audience but not approaching her might continue to build her confidence working in education programming.

Color Discrimination Behavior

Staff wanted to establish a show behavior that demonstrated Corvids intelligence and their ability to distinguish between various colors. The behavior would involve a Corvid coming out to the stage, picking up a specific colored peg amongst other colored pegs, and taking the peg to the trainer. "Ginnie" would fly to and pick up a colored stick. Originally the color discrimination was trained inside her enclosure. Since the raven already knew a retrieve behavior (the donation box behavior) she learned how to pick up a yellow peg and take it to her trainer very easily. Once placed with the other colored pegs, she was only reinforced for retrieving the yellow peg. This behavior translated very easy to the theater space. However in order for the audience to see the various colored pegs displayed on stage, trainers had to now develop a board that would hold the pegs vertically. The board was a constructed out of a 2ft by 1 & 1/2 ft piece of plywood with a piece of 2x4 attached. The 2x4 had 4 drilled slots to hold the different colored pegs (See figure 1). The board was novel and inherently aversive to "Ginnie", so trainers had to go back to habituating her to the board inside her enclosure. "Ginnie" would also be required to land on the board in order to grab the colored pegs. Once she was comfortable inside her enclosure, trainers moved to the theater space but the board behavior did not translate as easily as the pegs. It still took a lot of confidence building doing short approximations to the board before "Ginnie" tolerated landing on it. Since the pegs

were already established as a way for her to earn high reinforcement, they were added in to help give "Ginnie" more incentive to go to the board. Once "Ginnie" was hopping to the board from short distances and retrieving the yellow peg, trainers wanted to incorporate an entrance and exit from backstage which required a longer flight to the board. However since "Ginnie" was not always comfortable flying to the board from a longer distance, trainers had to re-evaluate her behavior criteria. Trainers realized that by relaxing her criteria she would be able to successfully complete this behavior in shows. On her entrance "Ginnie" was allowed to fly in from backstage and land anywhere she felt comfortable and then hop over to the board to retrieve the peg. Reminding trainers that they should never be too proud to change training plans or simplify it when something doesn't work. Over the course of training this behavior, trainers also learned that things would have gone faster had started with original show props including the peg board. "Ginnie" was able to be used in a new show called "Beaks!" starting in February 2015.

Figure 1: Shows the board constructed to hold the colored pegs for the color discrimination behavior.

Other Behaviors

Several other behaviors were trained with "Ginnie" as well. At one point trainers considered putting her in an outdoor show so a telemetry back pack was placed on "Ginnie" and training began to allow her trainers to turn a radio transmitter on and off. This would involve trainers reaching over her back and touching her back with a magnet for several seconds. Due to her sensitivity initially this did not go well. A target was added in the form of a carabiner attached to the side of a cage. The target allowed "Ginnie" to have a clearer criteria of what was expected while the trainer was turning on and off the telemetry unit. "Ginnie" had to hold the carabiner and remain on the perch while trainer's touched a magnet to her back, thus turning on her telemetry.

Directors also wondered if "Ginnie" could learn to hold or swing a Pittsburgh Steeler's terrible towel for a National Aviary social media video. Knowing "Ginnie's" history and sensitivity to new objects, trainers were able to train this behavior quickly using the proper techniques. As a form of habituation, the terrible

towel was left inside her enclosure as a an enrichment item, once she was desensitized to the towel, she was trained using positive reinforcement to pick it up and walk with it inside her enclosure.

Discussion and Conclusion

Upon her initial arrival at the National Aviary, “Ginnie” was very nervous of people and any novel objects placed in her enclosure. Through positive reinforcement training, habituation, and a lot of patience, “Ginnie” has been able to learn of variety of different behaviors. Trainers were reminded that they should never be unwilling to change training plans or simplify it when something doesn’t work. Although “Ginnie” still has certain sensitivities, trainers’ willingness to work through some of these issues have allowed her to perform behaviors in front crowds of visitor’s, thus teaching visitors about these amazing birds and their intelligence. In early 2015 “Ginnie” managed to successfully complete her terrible towel behavior without hesitation for a NBC television crew. “Ginnie’s” brief spot aired during a Pittsburgh Steelers playoff game for a National Aviary promotion. “Ginnie’s” ability to be used as an education bird and her success with the media promotion shows that different training techniques can be used to help improve a bird’s confidence and inherently their welfare.

Since her initial debut in “Beaks!” “Ginnie’s” behavior in late June regressed and she had a re-established fear of the peg board. However by taking a few steps back and re-habituating her to the board inside her enclosure, “Ginnie” is becoming more confident flying to the board. In the future trainers plan on continuing to train “Ginnie” for a variety of different behaviors in different environments which will help to build her confidence at the National Aviary.

Works Cited

Marzluff, J. M., R. Miyaoka, S. Minoshima, and D. J. Cross. "Brain Imaging Reveals Neuronal Circuitry Underlying the Crow's Perception of Human Faces." *Proceedings of the National Academy of Sciences* 109.39 (2012): 15912-5917. Web.

Ramirez, Ken. *Animal Training: Successful Animal Management through Positive Reinforcement*. Chicago, IL: Shedd Aquarium, 1999. Print.

Weir, Alex A. S., and Alex Kacelnik. "A New Caledonian Crow (Corvus Moneduloides) Creatively Re-designs Tools by Bending or Unbending Aluminium Strips." *Anim Cogn Animal Cognition* 9.4 (2006): 317-34. Web.

Training Dominant Expressive Behaviors in a Social Group of Variable Flying Foxes (*Pteropus hypomelanus*) and African Straw-Coloured Fruit Bats (*Eidolon helvum*)

By

Ellen Dreyer, Austral/Asia Keeper

Brevard Zoo

Melbourne, FL

Abstract

Brevard Zoo currently houses 0.5 Variable flying foxes (*Pteropus hypomelanus*) and 3.0 African straw-coloured fruit bats (*Eidolon helvum*) in the aviary of the Austral/Asia area. To improve husbandry and veterinary care, the bats were trained to spread their wings on cue for visual inspections, mental stimulation, and guest presentations. Because wing spreading can be an expression of dominance, the techniques used to train the behavior had to be significantly changed depending on the dominance hierarchy of each individual. Dominant bats frequently spread their wings as a display of their dominance so a mix of shaping and capturing was used to bring the behavior under stimulus control in those individuals. Submissive animals needed repeated small approximations, increased distance between the bat and the trainer when asking for the behavior, and involvement in group training sessions in order to achieve the behavior. The time needed to train the behavior was less for more dominant bats and greater for more submissive bats. Observational learning also occurred in both more dominant and more submissive bats that were able to learn the behavior by watching other bats' training sessions. Every bat was able to learn the behavior with various combinations of techniques based on their hierarchy in the colony.

Introduction

Brevard Zoo maintains a colony of 0.5 Variable flying foxes and 3.0 African Straw-coloured fruit bats. The bats have a night house where they are separated into howdy cages to eat at night and an exhibit they are shifted to during the day which is attached to the night house by a hallway with a 1 x 1 wire pathway. Little training was done with the bats in the past due to time restrictions, exhibit limitations, and a lack of knowledge of methods of training bats and their capabilities. But, an injury to the patagium of one of the flying foxes necessitated a better way to inspect the wings of each bat for tears or holes without causing additional stress to the animal. A training plan was written to achieve voluntary wing presentations from each bat to allow them to participate in their care. This paper will focus on three Variable flying foxes with different degrees of dominance in the social group.

Methods

The first step was to desensitize the bats to eating food given to them from the trainer. Since none of the bats were used to being handed food or having a keeper near them for an extended period of time, we

desensitized the group by offering favorite foods to them twice a day for fifteen minutes at a time for a week. Initially, pieces of fruit from the bats' diets were used. A syringe filled with banana baby food was also tried and found to be more convenient because a little bit of baby food could be quickly given for reinforcement. Next, a whistle bridge was introduced to all of the bats. After establishing the bridge, we then trained the flying foxes to station to a specific station made of a different colored plastic block for each bat. This behavior was important for training on exhibit where space is limited (see Fig. 1).

Figure 1. One bat is reinforced for a wing presentation while the other bats stay at their stations.

Training the dominant bat

To begin training wing presentations, one of the most dominant flying foxes in the social group, named Divine, was singled out to start. Because of time restrictions, training one bat at a time was initially the easiest way to begin. Wing presentations are often used by bats to show dominance over other bats so a dominant animal that more often displayed the behavior naturally was deliberately chosen.

The first session took place in the night house after all of the other bats had been shifted out. A small wood dowel was presented in front of Divine. She was naturally curious and grabbed the dowel with her right thumb. She was bridged and reinforced every time she grabbed the dowel (see Fig. 2). After a few training sessions where she was rewarded for grabbing the dowel, the dowel was placed farther from her thumb causing her to reach out more to grab it. The dowel was alternated on either side of her body to encourage her to reach with both her right and left thumb. Training sessions were short, often lasting 10 minutes or less but frequent with 3 to 4 in a day. She was separated from the other bats to keep her focus on the trainer for all of the sessions.

Figure 2. When Divine grabs the wood dowel, she is bridged and reinforced.

Another important facet of the training was to bridge and reinforce her for spontaneously presenting her wings to encourage the behavior (Ramirez 1999). We did this technique to increase the frequency of the behavior but we mainly focused on shaping the behavior during formal training sessions so that we would have approximations to fall back on if the behavior broke down. Divine occasionally presented her wings on exhibit and often presented her wings when she shifted into the night house at night. Any time Divine stretched out a wing whether she was grooming herself, displaying at another bat, or hot, she was bridged and reinforced if the trainer saw the behavior.

Her training progressed quickly. After placing the dowel as far as she could reach, the dowel was then used to prompt the action of stretching out her wing without her actually grabbing it (see Fig. 3). She then offered a full wing presentation on her own and was immediately jackpotted with a high level reinforcer. The combination of shaping the behavior with the dowel and capturing the behavior by reinforcing when she stretched out her wings ultimately resulted in Divine learning to present her wings for inspection. Initially, any wing was rewarded. Six sessions after the first on cue wing presentation, the trainer was able to shape and pair a separate discriminative stimulus (SD) for the right wing, left wing, and both wings. Other bats were then allowed to be present during Divine's training sessions both in the night house and on exhibit with the use of stations to keep the other bats from getting in the way.

Figure 3. The dowel is used to prompt Divine to present her wing.

Training a less dominant bat

The next bat singled out for training was a female named Hershey, a less dominant bat. She was skittish around people to start. Several beginning sessions were spent asking her to come to the trainer for a reinforcer. This quickly resulted in her seeking out the trainer for reinforcement on her own. After learning to target her thumb to the dowel like Divine, she made little progress during training sessions. Instead of fully extending her wings when prompted, she would stick her thumb straight out which did not allow for a good visual inspection of the patagium, defeating the purpose of the behavior. The trainer decided to use behavior momentum, the process of asking for several easier behaviors more likely to be performed before asking for a behavior that is less likely to occur, to make progress (Luu, 2014). The trainer asked Hershey to come for reinforcement at various places in the night house, a low energy and easy behavior. When the trainer walked across the night house to the other side and held up the reinforcement, Hershey instead stretched out her wings and held them until she was bridged. She repeated the behavior when the trainer walked back across the night house and asked for her to present her wings. The trainer was able to move a few steps closer to Hershey each time the behavior was asked for. Within three sessions, the behavior was shaped into right, left, and both wings with a separate SD for each. The trainer's proximity to Hershey played a large role in her willingness to display her wings initially.

Training a submissive bat

Different techniques were also used for one of the more submissive bats, a female named Corona. Corona learned to target her thumb to the dowel the same time that Hershey did. But, she also stalled in her training after this step. Unlike with Hershey, decreasing the trainer's proximity to Corona during training sessions did not have a noticeable effect. The trainer also tried separating her from the group since we were asking for a dominant expressive behavior but she retreated from training sessions and waited by the shift door when she could not see the other bats. To solve this problem, we shifted in Divine, Hershey, and Corona in a group. The trainer first did training sessions with Divine and Hershey with Corona present (see Fig. 4). After training them, they were shifted into howdy cages where they were visible but not distracting to Corona. Next, we worked on small approximations to get Corona reaching her thumb out as far as possible using the dowel prompt but not letting her touch it. During one session, Corona began rocking her body back and forth, a precursor to a wing presentation, but she did not extend her wing. She was reinforced for rocking. At the end of the session, she shifted into her howdy cage and immediately did a wing presentation. She was reinforced. The trainer asked for the behavior and she presented her wing again. She was jackpotted with high value reinforcement. But, the next three sessions she did not do any wing presentations. We noticed Corona began rocking her body when the trainer reached down to refill the syringe with banana baby food. The trainer then knelt on the floor with Corona in the howdy cage above, showed her the reinforcement, and asked for a wing presentation. She presented her wing. The trainer was slowly able to stand a little higher each session but it took over a month before Corona would do the behavior when cued without the trainer crouching at all.

Figure 4. Divine and Hershey do a left wing presentation while Corona is present in the background.

A contributing factor to Corona's lack of progress was likely because of too much repetition of asking her to grab the dowel rather than removing the dowel prompt. Because she was used to grabbing the dowel, she would stretch out her thumb when cued but not spread her wing out, preventing a visual inspection of the patagium. Using behavioral momentum during training sessions combined with the increased vertical distance between the trainer and the bat showed an immediate increase in Corona presenting her wing on cue. Initially, Corona was reinforced for a single wing presentation then given her entire diet. This was done not only for motivation but to keep her more focused. We noticed she would sometimes try to get to the other bats' diets and leave the training session. To encourage her to stay at the training session, we kept the sessions short and fed her after a single behavior then increased the amount of behaviors we asked for each session. She soon stopped leaving training sessions to investigate what the other bats were eating.

Observational learning

Brevard Zoo has 3.0 African straw-coloured fruit bats in addition to the Variable flying foxes. They used to act skittish and always moved away when keepers were near them. While training Divine on exhibit, one of the African straw-coloured fruit bats approached the trainer and extended both of his wings. He was reinforced and the behavior was quickly brought under stimulus control. The two other African straw-coloured bats also learned the behavior by watching training sessions with other bats, a demonstration of observational learning. Since implementing a positive reinforcement training program for the straw-coloured fruit bats they now move toward keepers and seek out interaction by calling, flapping their wings, and offering behaviors.

Discussion

Training a dominant expressive behavior proved challenging in more submissive bats. Breakthroughs occurred when we increased the space between the trainer and the animal both by moving farther away and by crouching to give the bat more vertical space. Observing the animal's response to even minor changes like the trainer bending over to get more reinforcement was crucial to making initial gains toward the ultimate goal. The trainer was able to bring the behavior under stimulus control in fifteen sessions with the most dominant bat, Divine. The less dominant bat, Hershey, took double the amount of training sessions.

The most submissive bat, Corona, took approximately three times as many training sessions as the dominant bat to bring the behavior under stimulus control.

Because bats are highly sociable, having other bats present but in separate cages was important when training submissive animals. Being willing to try various arrangements depending on the individual being trained such as being on or off exhibit, having other bats present or training them alone, and having bats together or separated into howdy cages was important. Trainers quickly learned one size does not fit all.

A possible reason for why the behavior took much longer to train in some bats was the use of the wood dowel. While using the dowel prompt was helpful in the beginning, fading the prompt quicker might have decreased the amount of time it took to bring the behavior under stimulus control in some of the bats. Prolonging the use of the prompt hindered their "cue-behavior-reinforcement" understanding during the shaping process (Martin, 2014). They became stuck on reaching out with their thumbs when prompted with the dowel rather than learning to spread out their wing.

To encourage the more submissive bats, we used small approximations to give them lots of opportunity for reinforcement. And, behavioral momentum kept the pace of the training sessions moving forward rather than stalling on the harder behavior.

Besides improving the husbandry and veterinary care of our bats, this behavior allows us to give dynamic guest talks where the public can see the bats interacting with trainers in a positive way. We are able to connect the public to bats, change the negative image of bats, and educate people on the issues bats are facing in the wild.

Acknowledgements

A special thanks to the entire hardworking Austral/Asia team at the Brevard Zoo. Also, thanks for the support of senior staff particularly our Zoological Managers, Chad Davis and Dave Quavillon, and our Curators of Animals, Tracy Sorensen and Kerry Sweeney. Thanks also to the Director of Animal Programs, Michelle Smurl, for her guidance.

Literature Cited

Luu, P. 2014. *Understanding Behavioral Momentum and It's Applications to Establish Effective Behavioral Change*. Presented at the Organization for Reinforcement Contingencies with Animals: Art and Science of Animal Training Conference, Denton, TX.

Martin, S. 2014. *The Right Tool for the Job.* Presented at the Animal Behavior Management Alliance conference: Getting to the Heart of Behavior Management in the Heart of Texas, Dallas, TX.

Ramirez, K. 1999. *Animal Training: Successful Animal Management through Positive Reinforcement.* Chicago, IL: John G. Shedd Aquarium.

At Arm's Length: Training 0.2 Black Rhinos *(Diceros bicornis)* for Free-Standing Transrectal Ultrasounds

By

Kevin Scotti, Animal Keeper

Cleveland Metroparks Zoo

Cleveland, Ohio

Abstract

For the past decade and a half, Cleveland Metroparks Zoo has had a successful Black Rhino (Diceros bicornis) breeding program. Led by Alisa Sandor, Lead Animal Keeper, and Dr. Mandi Schook, Associate Research Curator, our staff looked for new methods of gathering information which could ultimately help further rhino breeding success. Staff decided to begin training our rhinos for free-standing transrectal ultrasounds. This would allow us to closely monitor the progress of the first successful pregnancy by natural breeding of one of our female rhinos and it would provide an avenue to more accurately track estrus cycles of both of Cleveland Metroparks Zoo's two oldest female Black Rhinos. Finally, it could provide a transition point to train for a long-term objective of potential artificial insemination. Some strategies used to obtain this behavior relied heavily on the pre-developed husbandry relationships that existed between animal care staff and the rhinos. Some behaviors needed refined, while others needed created in order to reach our goal. This presentation explores the training methods utilized in acquiring this behavior, hopefully adding yet another tool to help zoo rhino populations.

Introduction

Black Rhinoceroses *(Diceros bicornis)* are one of the world's most critically endangered mammals. They have had the most drastic decline of total numbers of individuals over the past century of any other rhino species, losing 96% of its wild population (International Rhino Foundation, 2015). There are thought to be only 5,055 Black Rhinos remaining in the world (IUCN African Rhino Specialist Group, 2013). Cleveland Metroparks Zoo (CMZ) is home to 1.3 Black Rhinos. The rhinos at CMZ include Inge

our oldest female at approximately 22 years of age, along with her daughters Kibibbi, 12, and Johari who just turned 5. Juba is our only male rhino. He is Kibibbi's son and turned 3 in July.

The decision was made to begin training our two oldest rhinos, Inge and Kibibbi, for transrectal ultrasounds. This behavior would allow us to monitor the progress of Kibibbi's pregnancy, as well as to provide a better understanding of the timing and length of rhino estrus cycles. Once this new behavior was trained it could provide a progression point to potential attempts at artificial insemination. At the time, we did not have access to a training chute inside of the rhino barn. After discussing our options with our Curators, Veterinarians and the Conservation and Science Research staff we felt confident in the ability to train this behavior safely in a protected contact, but free-standing manner.

Methods

Without the use of a training chute, we understood that the behavior would need to be acquired in a safe, slow and comfortable time table for both rhinos and staff. Introducing individuals who were unfamiliar to our rhinos was a step that did not take very much time. Our rhino barn is one of the most oft toured areas at CMZ, so the rhinos were already very comfortable with different faces, including Dr. Mandi Schook our Associate Research Curator who would be performing the ultrasounds. Dr. Schook would take the time being around the barn from the very beginning stages of approximations. We would initiate training the behavior by combining two learned behaviors, "target" and "lean in", and then adding additional adaptations for the tactile portion along the backend of the rhinos. The reinforcement that would be used was a combination of sliced produce (apples and carrots) along with alfalfa cubes. Our rhinos have gotten accustom to the verbal bridge "Good". The primary trainer would work the individual rhino from a protected contact setting inside of our first rhino holding stall (Stall 1). The rhino would be closed off in the adjacent stall (Stall 2). The trainer would cue "target", then bridge and reinforce the behavior. Next would be the "lean in" cue. It was optimal for the rhino to be positioned with its backend nearly touching the front side of Stall 2 while staying parallel to the side panel bars of Stall 1, so that Dr. Schook would be able to have the reach necessary to obtain the ultrasound. Once again, this process was learned quite quickly by both rhinos. Though their positioning within Stall 2 was new, the behaviors were already well cultivated. The next steps would prove to be somewhat more challenging, as we would now introduce the rhinos to Dr. Schook touching various sites on their hindquarters. She did so while wearing the medical apparel full arm length plastic gloves that would be used during the ultrasounds. There was little to no adverse response by either rhino with this new stimulus. The subsequent progression of the training would have Dr. Schook beginning to touch, grab and manipulate the tail of the rhino. This was done utilizing several training sessions over the course of several days.

After many sessions of approximations, the following move was to begin using a lubricant on the glove and to begin palpating around and eventually inside of the rectum. As these sessions progressed, it was apparent that our primary reinforcement, sliced produce, would be enough to maintain the attention of both rhinos during the procedure. Once Dr. Schook felt comfortable enough with palpations obtaining optimal distance needed for the ultrasound to work, the hand-held ultrasound probe was introduced. Initially, the reinforcement would be near constant. Eventually, we would be able to decrease the constant reinforcement and we also began using alfalfa cubes amongst the apples and carrots so as to not overload our rhinos with produce. Almost immediately, Dr. Schook was able to obtain views of the reproductive systems of both rhinoceroses, which had never before been achieved in the history of Cleveland Metroparks Zoo.

Results

Both females responded to the first aspect of training this behavior as expected, very quickly. The “target” and “lean in” cues were established behaviors already ingrained into both Inge and Kibibbi’s normal husbandry routine. The slow, tactile portion with Dr. Schook manipulating at the hindquarters of both animals was also achieved fairly quickly. Inge and Kibibbi learned the behavior at near simultaneous rates. Once the internal practices began occurring, we noticed the need to use more produce as a primary reinforcement to maintain the attention of the rhinos in this part of the training. Inge seemed to be more comfortable than Kibibbi with the transrectal manipulations. Therefore, we did not need to be as constant with her reinforcement. Kibibbi at times, even to this very day, can act a bit more restless during the ultrasounds. She did need more consistency of reinforcement to allow for the procedure. However, both rhinos have now been able to be transrectally ultrasounded on an as needed basis.

Discussion

Inge and Kibibbi are both unique cases in terms of their comfort level in training with our staff. Alisa Sandor has worked with Inge since the rhino’s arrival to Cleveland in 1998. Their established training relationship is closing in on 20 years. In turn, Alisa has been part of Kibibbi’s life from the time she was born in 2003. I believe this cannot be highlighted enough in terms of the comfort level and trainability of these rhinos. The cooperation and communication between staff members at CMZ provided an opportunity to safely and successfully train this behavior without the use of a restraint. The ability to now perform transrectal ultrasounds on two of the most genetically important Black Rhinos in North America is a grand achievement for all of us in this profession. The information that researchers can now obtain from these ultrasounds may prove invaluable.

Acknowledgements

Cleveland Metroparks; Cleveland Metroparks Zoo; Dr. Chris Kuhar, Executive Director of Cleveland Metroparks Zoo; Andi Kornak, Director of Animal and Veterinary Programs; Travis Vineyard, Curator of Animals; Chris Peterson, Associate Curator of Animals; Dr. Albert Lewandowski, Chief Veterinarian; Dr. Mike Selig, Staff Veterinarian; Dr. Mandi Schook, Associate Research Curator; Alisa Sandor, Lead Animal Keeper; Africa/Rhino/Monkey Island Animal Keeper Staff at Cleveland Metroparks Zoo

References

International Rhino Foundation, 2015 rhinos.org.

International Union for Conservation of Nature, 2013 African Rhino Specialist Group, rhinos.org