Proceedings of the 47th Annual American Association of Zoo Keepers National Conference

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Papers

Table of Contents

Training the Herd, Not Just the Cow
Amy Goswell, Toronto Zoo

Rolling with it: Savanna Enrichment Renovation
Lauren Sutherland-Cook and Katie Graves, Woodland Park Zoo

Working as one Group for Gorillas" Connecting research to husbandry management for the best care of Cleveland Metroparks Zoo's Western Lowland Gorilla troop
Laura Klutts, Cleveland Metroparks Zoo

AAZK International Outreach Committee
Yvette Kemp, AAZK International Outreach Committee

For Flock's Sake: Creating a Plan for Poor Feather Conditions in a Lorikeet Flock
Heather Lester, Denver Zoo

Rethinking Black-tailed Prairie Dog Care and Management
Rachel Hughes, Frank Buck Zoo

Wildlife Protection & Human-Wildlife Coexistence Across the Lewa-Borana Landscape

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Manuscript Description: *Below is a brief curated update related to Lewa Wildlife Conservancy's wildlife conservation efforts in 2021 and 2022, as well as looking ahead to 2023. The conference speaker will briefly touch upon this information, provide an update on the rhino populations on the Lewa-Borana Landscape, and share insights on their conservation research working alongside Lewa's Kenyan team and partners.*

Lewa Wildlife Conservancy Overview

Lewa Wildlife Conservancy (Lewa) is a UNESCO World Heritage Site, Man & Biosphere Reserve, and IUCN Protected and Conserved Green List Area that works as a catalyst for the conservation of wildlife and its habitat across northern Kenya. Lewa does this through the protection and management of species, the initiation and support of community conservation and development programs, and engagement of local communities in conservation. The Lewa-Borana Landscape (LBL) is a 93,000-acre protected sanctuary for some of Africa's most threatened wildlife, including 15% of all Kenyan Southern White rhino and Eastern Black rhino (*Ceratotherium simum ssp. simum* and *Diceros bicornis ssp. michaeli*), as well as thriving populations of more than 400 African Savanna elephants (*Loxodonta africana)*, 11% of the global population of Grevy's zebra (*Equus grevyi)*, large-bodied carnivores like African lion (*Panthera leo)* and Spotted hyena (*Crocuta crocuta)*, and several species of ungulates, primates, more than 480 bird species, and reptiles.

Lewa's community development initiatives benefit more than 60,000 people per year, including ~8,000 students from 23 Lewa supported schools who gain access to a quality education, and 1,800 women who leverage Lewa's micro-loan program to start their own businesses, reducing gender inequalities. Additionally, more than 40,000 people have access to healthcare through Lewa's partner clinics and over 25,000 people have access to clean water via 16 local water projects. Lewa also supports locally led forestry conservation efforts and sustainable agriculture practices in surrounding communities.

Wildlife Protection Across the Lewa-Borana Landscape (LBL)

Amidst slow recovery of tourism revenue and challenges brought on by the worst drought in four decades, Lewa remains steadfast in its efforts to protect wildlife and people in northern Kenya. The Conservancy has managed full retention of 158 field rhino monitors, fence monitors, armed anti-poaching personnel, and rapid response personnel in 2021 and 2022, while providing the ongoing professional development and safety education for rangers to maintain their technical

skills. The Conservancy's technical teams upheld unified operations and management of the Joint Operations Command Center (JOCC), and security teams acted quickly and proactively to protect both wildlife and people within and around the LBL.

The security team of 118 rangers, in partnership with the Borana Conservancy's security team, achieved a zero anti-poaching record across the LBL from 2020-present date. The rhino population has exceeded 255 on the LBL, comprising 15% of all Kenyan rhinos. The Conservancy also maintained 10% black and 11% white rhino annual growth rates in 2021, significantly exceeding the national target of 5% outlined in Kenya's Black Rhino Action Plan (2017-2021). The Proportion of Illegally Killed Elephants (PIKE) in northern Kenya was recorded at a relatively low 25% in mid-2022, reflecting a 12% decrease from 2020. This was made possible in collaboration with other partners, including the Northern Rangelands Trust (NRT), Kenya Wildlife Service (KWS), and communities in the region.

EarthRanger remains a critical tool, allowing Lewa, Borana Conservancy, and 39 NRT community conservancies to aggregate significant amounts of data into a single platform and monitor a vast landscape of more than 10 million acres in real time. As a result of this data, security personnel were able to address key threats, exacerbated by the pandemic and prolonged droughts, including poaching; habitat degradation; competition for resources with livestock; reduction of water sources and restricted access to water; human-wildlife conflict (HWC); human-elephant conflict (HEC); insecurity and migration; wildlife disease; and predation of livestock that affect communities' livelihoods and food security.

EarthRanger is now transforming protected area management throughout Kenya as it has been adopted at the national level by KWS with the goal of connecting every protected area in Kenya to a centralized system. Outside of Kenya, EarthRanger is now utilized in 188 protected areas (www.earthranger.com) and counting since being developed in partnership with and piloted in Lewa in 2016.

Mitigating Human-Wildlife Conflict (HWC)

HWC mitigation remains a key priority for Lewa, and our philosophy is anchored in working with surrounding communities to help individuals see tangible value in conservation and supporting the protection and care for wildlife and their habitats. Through years of building and maintaining trust, we are witnessing an improved level of coordination and cooperation between Lewa and the local communities, which has contributed to the decreasing HWC and human-human conflict (HHC) incidents we are observing. In the past year, the newly formed HWC rapid response unit confirmed that community members will practice patience and caution when they are confident that a team will respond to a reported issue in a timely manner. In 2021, 45 HWC cases were recorded which is down from 104 cases in 2020 and 117 in 2019. However, extended dry seasons intensify competition for water and grazing land and push wildlife to look for food in nearby

community farmlands. This inevitably results in fence breakages, crop damage, loss of livestock and other property, and can antagonize relationships between communities and Lewa.

From October 2021 to May 2022, Lewa's HWC Rapid Response Unit recorded and successfully addressed 29 HWC cases (mostly caused by elephants and baboons) through timely responses, safe wildlife deterrent methods, community education and training, and data collection as supported by EarthRanger to inform proactive patrols in high-risk areas. **Overall, the Response Unit helped reduce HWC cases by 17% from the previous eight-month period.**

Lewa also recorded four cases of wildlife attacks on livestock resulting from the prolonged drought that prompted herders to search for rangelands closer to the protected areas and unfenced community conservancies where predators roam.

Human-Human Conflict (HHC) Cases

Lewa recorded a total of 12 HHC cases from October 2021 to May 2022, indicating a 40% decrease from the last eight months. While managing HHC cases remains a challenge due to devastatingly dry conditions and resulting added pressures on natural resources and livelihoods, drawing real-time monitoring data from EarthRanger allowed Lewa's team to see where animals were located, gain a bird's eye view of how humans affected wildlife movement, and actively protect important wildlife passageways within and around the Conservancy. Without the accurate, timely intel from EarthRanger, the incident rate would be undeniably higher in current conditions.

Ongoing Challenges for Wildlife Conservation in the LBL

A total of seven tusks have been recovered from 2020-present date. Five of the tusks recovered were from natural death rather than from poaching activities. There are relatively low cases of bushmeat hunting within the Conservancy (one in 2021). Those that occur are attributed to the severe drought that led to insufficient food for both people and animals. With poor harvests, communities begin to look for alternative sources of livelihood that include bushmeat hunting. Additionally, the extensive droughts weaken the majority of wildlife species such as buffalos, making them vulnerable to hunting by humans.

To this end, in May 2022, the conservation team identified specific rhinos (those more vulnerable including older, breeding rhinos and lactating mothers) and a broader subset of additional wildlife species that will be on a targeted supplementary feeding program for the next three months to provide a nucleus of animals the greatest opportunity to survive the drought until the next rains expected in October 2022.

Lewa's CEO, Mike Watson, shared *"We have had our first delivery of hay and lucern in May and the conservation and security teams will be coordinating the distribution to identified feeding*

sites across the Conservancy, in a plan designed to last 4 - 5 months, if we don't have unexpected rains between now and then.

Several partners and lodges very kindly offered to assist with establishing their own feeding sites, proximate to their locations, which will be a helpful augmentation. Hay, lucern, and other supplementary feed is already becoming short in supply and prices are rising, so this will be an expensive exercise. Any contributions are very gratefully received, as we look to assist Lewa's wildlife in this challenging period."

Prioritizing the Ecological Carrying Capacity Study for Rhino on the LBL

Lewa will be conducting a study to determine the Ecological Carrying Capacity (ECC) for Eastern Black and Southern White rhinos by assessing the browse availability percentages, food suitability scores, other herbivore populations competing in the landscape, and related ecological dynamics on the LBL. Understanding the ECC of a landscape, defined as the maximum number of species held by the ecosystem in the existing conditions, is essential for sustainable conservation and management of wildlife. KWS recommends all rhino populations in a reserve be managed at 75% of the ECC to maintain high growth rates. The implications of a habitat that is close to exhausting or surpassing its ECC include competition for ecological resources, habitat degradation, increased opportunities for disease, reduced population performance, and more. To continue achieving sustained population growth and ensuring reproductive rates are not limited by the resource capabilities of the landscape, the ECC must be determined, and the relative rhino managed appropriately. Thus, it is critical to fill this ECC survey information gap to inform rhino conservation efforts and serve as a resource for other protected areas managing rhino.

The last ECC carried out on the Lewa was in 2006 for black rhino only, and estimates set the ECC at 70 animals, meaning the landscape is likely supporting populations beyond its capabilities. Rhino roam widely on the open savanna and within neighboring forest habitats, competing with other animals for resources, and are subject to the effects of a depleted browse base. It is important to investigate and understand this thoroughly, to ensure appropriate land management interventions are implemented. **Now a top priority for conservancies in the region, this KWS sanctioned study will aid in determining the larger regional standing of Kenya's rhino populations.**

Lewa will establish the current ECC for both white and black rhino that includes additional incorporated areas that were not studied in 2006, such as Ngare Ndare Forest, which most black rhinos are currently utilizing. Results from the study will help the Lewa research and management teams understand food options accessible to rhinos and implement actions to boost browse availability, such as adding more habitat recovery zones (fenced areas rhino can access but not elephants or giraffe) and limiting the number of competing browsers and grazers. Additionally,

the study will serve as a reference point for the intended relocation of buffaloes, whose numbers have rapidly increased on the landscape, and the potential translocation of rhinos to other protected conservancies with KWS's authorization.

A keystone species, rhino are landscape architects, and provide critical ecological services that support a healthy and balanced ecosystem. On a national scale, the breeding performance success of this black rhino metapopulation is vital in their strategic conservation that extends beyond the Conservancy. Listed as Critically Endangered on the IUCN Red List of Threatened Species, 32 black rhinos have been translocated from Lewa to establish rhino sanctuaries across the country, an effective metapopulation management tool to form genetically and demographically viable populations.

Despite the increasing population of white rhinos, which are listed by IUCN as Near Threatened, the ECC has never been established. The recently launched Kenya White Rhino Conservation and Management Action Plan (2021-2025) outlines conservation strategies and interventions, including rhino sites conducting ECC studies, to ascertain and implement effective conservation plans and key biological management tools, such as translocation. Therefore, the ECC study will help Lewa accomplish a key exercise outlined by the national management plan.

Additionally, outcomes from the EEC study will aid Lewa in maintaining a population growth rate exceeding 5%; establishing new rhino conservation strongholds via translocation; building the knowledge base for Lewa's conservation teams, key partners, Kenya, and Africa on the ECC of rhinos; monitoring rangelands health and forage trends; and securing the registration of the Lewa-Borana Landscape Ecosystem Management Plan.

Looking Ahead: Integrating LoRaWAN technology with EarthRanger

As Lewa helped develop and pilot EarthRanger in 2016, the Conservancy is now pursuing another global first for innovative conservation technology based around the EarthRanger system.

To optimize security and anti-poaching measures, Lewa is fundraising for and deploying LoRaWAN (Long Range Wide Area Network) gateways and LoRa (Long Range) sensors to bolster rhino management, law enforcement, and connectivity across the landscape. So far, the Conservancy has raised approximately USD$120,000 out of the USD$526,000 needed for this project.

Once funding is secured, Lewa will tag rhinos with LoRa-equipped sensors and install sensors on fences, vehicles, aircraft, and ranger equipment to enable real-time monitoring of wildlife and ranger movement, fence functionality, and integrity, as well as environmental changes. The

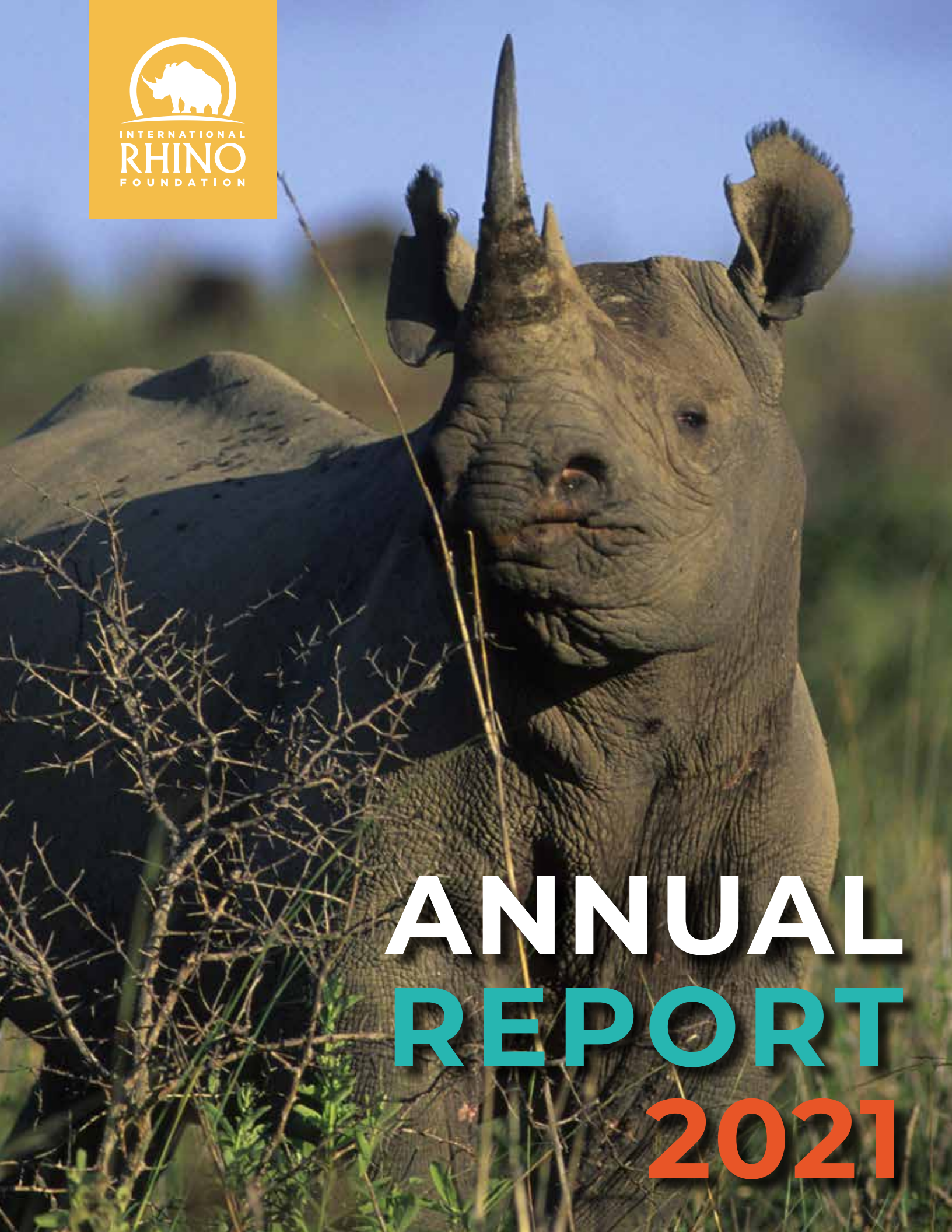
integration of LoRa in Lewa's conservation efforts will enhance wildlife security and generate accurate biological monitoring and evaluation data across the Conservancy's conservation impact programs. The LoRa sensors will be placed in strategic locations within the Conservancy that are considered vulnerable to illegal access and would be able to relay information when movement, metals, weapons, and other contraband are detected in such locations. These measures will significantly improve the effectiveness and safety of Lewa security responses and the overall safety of wildlife.

EarthRanger is the main platform for the application and deployment of LoRaWAN, and data collection templates have been revised to comply with the new data that will be captured through the roll-out of LoRaWAN. **Integrating LoRa with EarthRanger is a global first.** As Lewa pilots this integration, the Allen Institute, 51 Degrees, and others will look to integrate LoRa with EarthRanger in all global sites where EarthRanger is being used.

Table 1: Wildlife Counted in the Lewa–Borana Landscape, Feb. 2016 – Feb. 2022

Lewa - Borana Landscape Game Count							
	Dates: 2016 - 2022						
SPECIES	2016	2017	2018	2019	2020	2021	2022
Beisa Oryx	179	220	178	227	307	239	247
Buffalo	1220	1391	1623	1753	2086	2153	1901
Bush buck	15	17	16	15	15	15	5
Cheetah	8	1	4	5	6	7	8
Eland	280	192	322	291	245	358	331
Elephant	416	509	250	253	727	516	425
Gerenuk	10	10	11	10	10	11	16
Gazelle, Grants	348	443	415	718	1101	1145	1135
Gazelle, Thompsons	27	4	7	10	16	16	26
Giraffe	273	251	127	167	178	172	119
Greater kudu	28	35	22	32	32	32	32
Hippo	2	2	2	2	2	2	2
Hartebeest	30	62	64	64	93	91	92
Hyena, spotted	0	0	122	133	136	134	144
Hyena, striped	-	-	-	-	-	-	14
Impala	1113	1096	1763	1817	1505	1568	1285
Jackal (Silver backed)	9	12	6	7	14	22	6
Klipsringer	8	8	8	8	8	15	15
Leopard	7	8	9	9	9	9	14
Lion	17	44	45	47	53	61	57
Ostrich	51	44	41	52	65	83	61
Rhino, black	81	82	88	101	109	117	132
Rhino, white	70	75	80	87	97	107	118
Sitatunga	0	0	0	0	0	0	0
Warthog	68	85	140	161	168	162	151
Waterbuck	136	168	152	180	167	100	158
Zebra, Burchell	1262	1236	1228	1484	1599	1561	1557
Zebra, Grevy's	299	292	308	313	331	322	310

INTERNATIONAL RHINO FOUNDATION

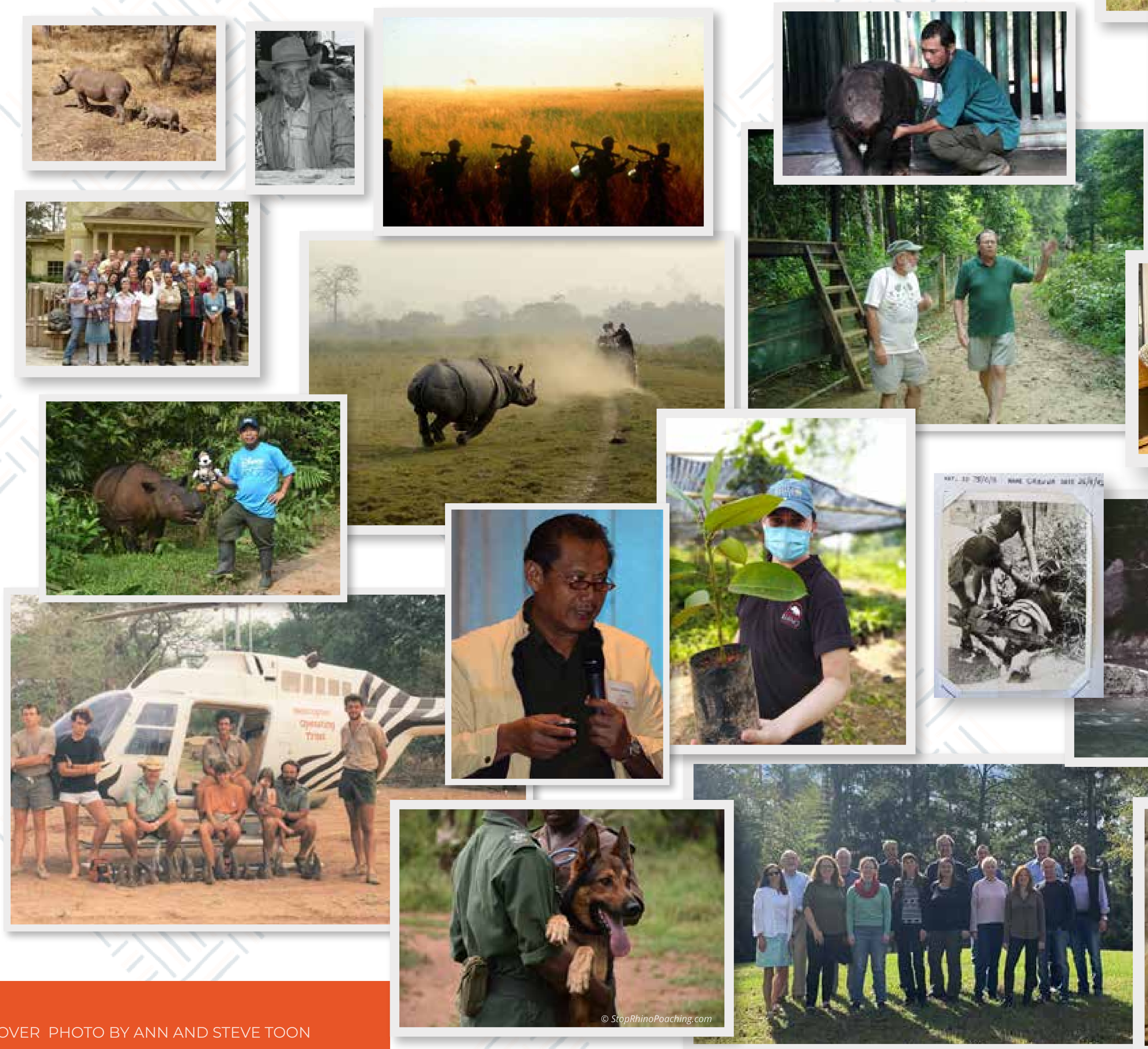


ANNUAL REPORT 2021

CELEBRATING **30 YEARS**

INTERNATIONAL RHINO FOUNDATION

FOR 30 YEARS, IT HAS BEEN ALL ABOUT PEOPLE, PLACES AND, OF COURSE, LOTS OF RHINOS!



COVER PHOTO BY ANN AND STEVE TOON

INTERNATIONAL RHINO FOUNDATION

Ensuring the survival of rhinos through strategic partnerships, targeted protection, and scientifically sound interventions.

© Robert Marc Lehmann

LEADERSHIP MESSAGE

Dear Team Rhino,

On May 14th, 2021, the International Rhino Foundation (IRF) celebrated its 30th anniversary. IRF was born when several concerned individuals came together in response to the black rhino poaching crisis in Zimbabwe in the early 1990s.

A few years later, IRF expanded our focus to include all five species of rhinos around the world. And for 30 years, we have held steadfast in our vision of saving rhinos from extinction. Over this time, we have learned from and collaborated with many smart and dedicated individuals, including researchers, organizations working on the ground and knowledgeable community members. And, of course, our dedicated members.

Through the years there have been challenges, successes, and lots of hard work. This past year was no different, as the global pandemic continued to impact the local communities and partners who we work with to protect rhinos and restore habitats.

In spite of the challenges, IRF expanded our programs in key areas, including Nepal, where we are working with local communities to restore habitat for greater one-horned rhinos, Zambia, where we are supporting important work to identify and disrupt criminal poaching networks, and Indonesia, where we expanded our long-term support of the highly imperiled Sumatran rhino. Your generous donations kept rangers in the field, funded new technology in the fight against poaching, and helped local communities that have joined efforts to improve habitats for rhinos and other wildlife.

We maintain hope and optimism for the year ahead, as countries open back up and badly needed tourism travel resumes. It will take time for local economies to recover; however, our experience over the past 30 years and our dedicated partners, staff and supporters give us confidence that we can overcome any challenge that we might face in our shared mission of ensuring all five species of rhino thrive in the wild.

Thank you,

JOHN LUKAS
President

NINA FASCIONE
Executive Director

STATE OF **THE RHINO**

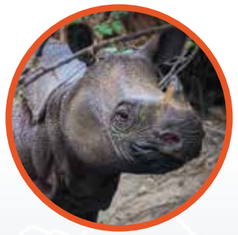
At the beginning of the 20th century, the worldwide rhino population was estimated at 500,000 individuals.

Now, just 120 years later, **only 28,000 survive.**

WHITE RHINO
Ceratotherium simum
NEAR THREATENED
17,212 - 18,915
POPULATION DECREASING
LOCATED IN: SOUTH AFRICA, NAMIBIA, KENYA, ZIMBABWE, ZAMBIA, BOTSWANA, ESWATINI, MOZAMBIQUE

BLACK RHINO
Diceros bicornis
CRITICALLY ENDANGERED
5,366 - 5,627
POPULATION INCREASING
LOCATED IN: NAMIBIA, SOUTH AFRICA, KENYA, ZIMBABWE, TANZANIA, ZAMBIA, BOTSWANA, MALAWI, ESWATINI, RWANDA, MOZAMBIQUE, CHAD

GREATER ONE-HORNED RHINO
Rhinoceros unicornis
VULNERABLE
> 4,000
POPULATION INCREASING
LOCATED IN: INDIA, NEPAL, BHUTAN



JAVAN RHINO
Rhinoceros sondaicus
CRITICALLY ENDANGERED
~75
POPULATION STABLE
LOCATED IN: INDONESIA

SUMATRAN RHINO
Dicerorhinus sumatrensis
CRITICALLY ENDANGERED
< 80
POPULATION DECREASING
LOCATED IN: INDONESIA

WHERE WE **WORK**

< ZAMBIA
Wildlife Trafficking Intelligence & Analysis

NAMIBIA >
Community Rhino Ranger Program

< ZIMBABWE
Lowveld Black Rhino Program

< ESWATINI
Anti-Poaching Support

SOUTH AFRICA >
Anti-Poaching Support

^ NEPAL
Habitat Management

< VIETNAM
Demand Reduction & Law Enforcement Capacity Support

INDIA >
Protection & Wildlife Crime Intelligence

INDONESIA >
Sumatran Rhino Conservation

INDONESIA >
Javan Rhino Conservation

IRF FOCUSES PROGRAM SUPPORT IN SIX KEY AREAS:

- PROTECTION
- COMMUNITY SUPPORT
- CONSERVATION BREEDING
- RESEARCH
- HABITAT RESTORATION
- DEMAND REDUCTION

TEAM RHINO **SPOTLIGHT**

Inspiring People to Act

Fresno Chaffee Zoo traces its beginnings to the late 1920s. The Zoo has undergone many changes in the decades since, with a mission to connect people to nature through experiences and challenge them to take their own actions to support wildlife conservation.

Next year the zoo will open Kingdoms of Asia, with a focus on Southeast Asian wildlife and habitats. The new experience will feature some animals that once or still share habitats with Sumatran rhinos, including Malayan tigers, Sumatran orangutans, songbirds, and others. The Zoo will also be highlighting its conservation partners which work to protect Critically Endangered species around the world.

Fresno Chaffee Zoo found itself in a fortunate position to provide additional funding for conservation projects at the end of 2021 and put out a call for proposals to all of its conservation partners. At the time, IRF was raising funds for our on-the-ground partner in Indonesia, Yayasan Badak Indonesia, to enlarge the maternity boma for Rosa to give birth in early 2022. The Zoo enthusiastically joined the project, providing significant funding.

"Sumatran rhinos are amazing, and we knew we could help build the program," said Dean Watanabe, Chief Mission Officer for Fresno Chaffee Zoo. "We are proud to have been a part of the birth of the new calf."

Directing Your Skills to What You Love

Eric Piesner's interests in the outdoors, animals and the environment were instilled at an early age even though he was born and raised in Brooklyn, NY. His father was adventurous by nature and a serious outdoor enthusiast. He fondly remembers trips to the countryside with his father.

Eric's adventure genes took him to Hawaii for law school and to Asia for his career. At each stop, he spent his free time learning about conservation and connecting to nature. Eric serves as a firm-wide Managing Partner, Asia Managing Partner, and heads Morrison Foerster's Asia Real Estate legal practice.

With more than 25 years of legal experience, Eric wanted to apply his skills to his conservation passion. He first connected with IRF as a donor and then as a volunteer with his Morrison Foerster colleagues. As he got to know IRF, we got to know him and value his skills and dedication to our mission. Eric officially joined IRF's advisory board at the end of 2021.

One of Eric's favorite quotes is from Dylan Thomas, "rage, rage against the dying of the light." He believes,

"We need to keep fighting for rhinos because nothing is impossible. The alternative is to do nothing, and that's ridiculous."

Running For Rhinos

Last year, Team Rhino laced up their shoes and took to the roads and trails to help rhinos

Founded in 2018, I Run 4 Movement has hosted more than 150+ virtual events celebrating with fitness fans across the country by creating unique opportunities to raise money and awareness for causes our community is passionate about.

In 2021, they launched the Save the Chubby Unicorn virtual run. Available as a 5 or 10k, the miles can be logged anywhere. With each entry, I Run 4 Movement makes a donation to IRF, supporting rhino conservation programs around the world. The event has proved to be very popular, raising more than $5,000 so far, and has been continued into 2022, providing a chance for runners to earn great rewards and help rhinos.

Last summer, IRF hosted its first ever virtual challenge, asking Team Rhino to run, walk, hike or even swim 30 miles in honor of our 30th anniversary. We thought the Rhino Protection Units (RPUs) of Indonesia would be the perfect inspiration for challenge participants since 30 miles is a normal day at the "office" for RPUs. RPUs spend 15 days at a time on patrol traversing rivers and climbing through dense rainforests to keep Javan and Sumatran rhinos protected.

The RPU Challenge ended on August 31 (the 26th anniversary of the beginning of the RPU program) and was a big success! More than 110 people registered for the challenge, raising more than $5,000 for rhino conservation and logging more than 3,300 miles in support of RPUs! Participants added up their miles throughout the summer. Miles were logged by runners, walkers, hikers and even a few swimmers as well.

Dr. Susie Ellis Honored for IRF's Work

The Living Desert Zoo and Gardens held the International Desert Conservation Summit in 2021 with a focus on "Restoring Rhinos in Africa" with a variety of expert panelists, including Dr. Susie Ellis, former executive director of IRF. Dr. Ellis also received one of the first Living Desert Conservation Hero Awards, accepting on behalf of the International Rhino Foundation.

Dr. Ellis also received the 2020 Lifetime Achievement AAZK Meritorious Service Award.

OUR **PROGRAMS**

GREATER ONE-HORNED RHINOS

2021 Highlights:

- *Poaching losses decreased to only one in Assam, India*
- *Population increased to more than 4,000 total across India, Nepal and Bhutan*

IRV 2.0 Takes Shape

The Indian Rhino Vision 2020 (IRV2020) program came to a close, with the translocation of two rhinos from Kaziranga National Park to Manas National Park in April of 2021. IRV2020 was established in 2005 with a goal to increase the rhino population in India's state of Assam to 3,000, by establishing populations in seven protected areas. Rhinos are now found in four Protected Areas in Assam: Pobitora Wildlife Sanctuary, Orang National Park, Kaziranga National Park, and Manas National Park.

Over the last year, the IRV 2020 partners met to outline goals for the coming years with plans to build on the successes and learnings from the previous program. Meetings to approve the plan, affectionately called IRV 2.0, have been delayed due to the global pandemic, but the hope is that the new program will begin in 2022 under the leadership of Assam Forest Department, along with supporting partners and translocations could commence again by the end of the year.

© Assam Forest Department and Indian Rhino Vision 2020

Working with Local Communities to Restore Habitat in India

One of the most significant landscape-level threats to greater one-horned rhinos is the prevalence of invasive species, which choke out native rhino food plants and limit the amount of habitat available for rhinos and other wildlife. IRF is collaborating with our NGO partner, Aaranyak, and local community members to remove these invasive plants from Manas National Park in India as a pilot phase, where around one-third of the rhinos' grassland habitat has already been taken over by invasive species.

Over the past year, local community members successfully restored 50 acres of prime rhino habitat under the supervision of Aaranyak and Manas National Park officials. We plan to restore another 250 acres over the next two years. Engagement of local people in removal of invasive plant species also offers them livelihood and in that way it helps park officials to garner better support from local communities along with improvement of grassland habitats.

IRF Expands to Nepal

IRF expanded our greater one-horned rhino conservation program to Nepal in 2021 by making our first grant to the National Trust for Nature Conservation (NTNC). The project has so far helped remove invasive plants and restore 100 hectares of rhino habitat in Chitwan National Park, home to the second largest population of greater one-horned rhinos in the world. Over the next two years, NTNC will remove invasive plant species from 250 hectares of grassland areas in the Park. Funds will be used to pay the wages of local community members, who manually uproot invasive species, and for supplies such as grasscutters, fuel, camera traps and batteries, as well as staff salaries of NTNC to monitor wildlife activity across the project sites.

SUMATRAN RHINOS

2021 Highlights:

- *More than 20,000 native rhino-food seedlings were replanted in Way Kambas National Park in Sumatra.*
- *Provided protection to one of the last viable wild Sumatran rhino populations, located in the Leuser Ecosystem in Sumatra, Indonesia.*

The Sumatran Rhino Breeding Program Expands

On Nov. 12, 2021, Indonesian government officials and conservation partners broke ground on a new Sumatran Rhino Sanctuary (SRS) in the Leuser Ecosystem in Aceh Province, on the island of Sumatra. The new SRS will be the third breeding facility, joining the current facilities in Way Kambas National Park in southern Sumatra (home to seven rhinos) as well as the small sanctuary in East Kalimantan that houses "Pahu," a female Sumatran rhino captured in 2018. The Aceh sanctuary is scheduled to be completed by October of 2022.

Sumatran Rhino Rescue Prepares for Captures

Sumatran Rhino Rescue is an international alliance supporting the Government of Indonesia's national Sumatran rhino conservation breeding program.

Despite ongoing delays caused by the pandemic and travel restrictions, Sumatran Rhino Rescue is moving forward with plans to begin capturing and translocating rhinos into the rhino sanctuaries in late 2022. During 2021, trainings were held via Zoom, with plans to convene in-person training as soon as possible. Topics include capture scenario planning, post-capture husbandry and immobilization drugs, some of the most critical skills required to safely capture rhinos.

Sumatran Rhino Rescue supports the Government of Indonesia's Emergency Action Plan for Sumatran Rhino Conservation, which lays out a roadmap for bringing this species back from the brink of extinction. Despite COVID restrictions, the government approved survey teams continue to patrol the rhinos' range area, documenting signs of rhino activity to ensure that captures, which could begin in late 2022, are as smooth as possible.

It is critical that these activities continue, despite the challenges of the global pandemic, for the survival of the Critically Endangered Sumatran rhino. IRF strongly feels that survival of the remaining population of Sumatran rhino is ever challenging, but not impossible to secure its future. IRF will continue to work closely with the Indonesia government and local partners to help secure the future of critically endangered Sumatran Rhinos.

© Nick Garbutt

JAVAN RHINOS

2021 Highlights:

- *Four new Javan rhino calves were born.*
- *Javan marine patrol halted more than 225 illegal fishing activities in its second year of operations.*

Monitoring Program Spots New Javan Rhino Calves in Ujung Kulon National Park

Indonesia's Ministry of Environment and Forestry announced in August that the world's only remaining population of Javan rhinos has increased to 75 individuals in Ujung Kulon National Park (UKNP).

In April and June 2021, two Javan rhino calves were spotted on camera by the Park's Javan Rhino Monitoring Team. This is the second set of births in 2021, and offsets natural deaths in the population.

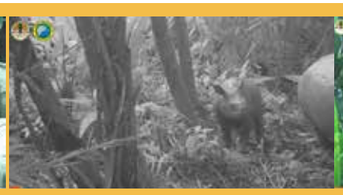
Cameras are positioned throughout the Park to identify individual rhinos and assist park officials in tracking new births for population counting. Through its on-the-ground partner, Yayasan Badak Indonesia, IRF provides support for this program, and donated one hundred new cameras last year to replace damaged or missing cameras.

Ten years ago, there were fewer than 50 Javan rhinos in UKNP, but with the Park's conservation efforts, the rhino population has been gradually increasing, with at least one new calf every year since 2012.

Javan rhinos are found only in Indonesia's UKNP, where the population appears to have stabilized, largely because they are guarded by terrestrial and marine-based Rhino Protection Units.

IRF appreciates the efforts being taken by Indonesia's Ministry for Environment and Forestry to secure the future of critically endangered Javan rhinos. IRF is committed to support the efforts of the Indonesian government where needed.

© Stephen Belcher

Images of Sumatran and Javan rhinos are courtesy of the Indonesian Ministry of Environment and Forestry

BLACK & WHITE RHINOS

2021 Highlights:

Twenty-nine black rhinos translocated, through a team exercise in which IRF funded planning and operational inputs, to reestablish a population in Gonarezhou National Park in Zimbabwe.

Provided legal training for 281 rangers and reserve managers in South Africa, empowering them to develop stronger court evidence against poachers and to ensure arrests are safe and effective.

In Zimbabwe's Lowveld, which contains three growing black rhino populations rated as "Key" by the International Union for Conservation of Nature, rhino poaching was kept at a low level in 2021, mainly through proactive work to disrupt poaching gangs, in which IRF provided funding support. ***More poachers (eight) were dealt with through this effort than the number of rhinos that they managed to poach in the Lowveld (five).***

Ranger Support and Training in South Africa

IRF's partner in South Africa is Stop Rhino Poaching (SRP), a local NGO that works with selected reserves throughout South Africa to improve security and anti-poaching efforts. A key component of SRP's work is facilitating specialized training on tracking, tactical first aid, information gathering, legal issues and other topics for rangers and reserve managers, all of which is enabled by the IRF's core support of the organization.

In 2021, amongst many other projects, SRP provided tactical first aid training and specialized trauma first aid kits for Kruger National Park's advanced night operations team, and trained 32 rangers from Welgevonden Game Reserve and Addo Elephant National Park on human tracking and operational readiness. Thanks to IRF's funding, 281 rangers and managers from over twenty rhino reserves across the country participated in SRP's innovative legal training program, developed to contribute to "technicality free" arrests and more successful prosecutions of rhino crimes. IRF's support has also enabled the roll out of a new training session, which aims to better equip managers and supervisors with the necessary legal knowledge of the journey a case takes beyond arrest. Important because of concerns surrounding the judicial process in some areas, this full-day session informs managers as to how they can keep a watchful eye on the court process and what they can influence if law enforcement officials are underperforming.

© Welgevonden Game Reserve

Black Rhinos Return to Gonarezhou

© Lowveld Rhino Trust

After nearly 30 years of absence, Critically Endangered black rhinos were reintroduced to Gonarezhou National Park by the Gonarezhou Conservation Trust's team of experts and partners. In July 2021, the International Rhino Foundation's partner in Zimbabwe, the Lowveld Rhino Trust (LRT), participated in a translocation to re-establish the initial population in Gonarezhou.

In all, 29 rhinos were translocated from three other areas of Zimbabwe - Bubye Valley Conservancy, Malilangwe and Save Valley, to establish the new population in Gonarezhou. The new population is doing well, in fact, towards the end of last year the first calf was born in the park.

The Gonarezhou Conservation Trust (GCT) is an innovative conservation partnership between the Zimbabwe Parks and Wildlife Management Authority and the Frankfurt Zoological Society that is responsible for the management of Gonarezhou National Park. IRF supported a feasibility study to assist in planning for this reintroduction and provided funding to support the translocations through the Lowveld Rhino Trust.

© Lowveld Rhino Trust

BLACK & WHITE RHINOS

Technology Deployed to Combat Wildlife Crime

Rhino reserves and neighboring communities faced huge economic losses as COVID-19 restrictions ground travel and tourism to a halt and governments reduced their conservation budgets. Many local reserves lost 70-90% of their conservation funding, jeopardizing their ability to keep critical intelligence and law enforcement operations in place. It will likely take them years to recover.

In 2020, IRF provided emergency funding through the Reserve Relief Fund to help bridge financial gaps. This year, IRF continued funding these critical protection and monitoring programs.

With the emergency grants to selected reserves, they have been able to maintain ranger salaries and proactive security patrols, maintain analyst capabilities, provide needed equipment and in some cases deploy technology to help counter the criminal syndicates involved in rhino poaching.

IRF has supported security clusters consisting of more than 20 rhino reserves in South Africa to install real-time security cameras and surveillance cameras, resulting in the apprehension of 22 poachers to date.

IRF supported Stop Rhino Poaching's mobile radar unit with high-tech surveillance capabilities that can be moved to poaching or incursion hotspots. Having flexible and responsive technological tools such as the mobile radar unit allow security teams to react quickly to poaching syndicates' ever-changing attacks on rhino reserves.

Poaching remains a highly-organized, well-funded and syndicated threat to rhinos' survival. IRF's nimble and responsive support ensures that reserve and security managers are better prepared to take on the poaching threat.

© Shannon Wild | courtesy of Southern African Wildlife College

RESEARCH UPDATE

The International Rhino Foundation (IRF) provides the only source of research funding devoted exclusively to rhinos, and over the past 20 years, we have issued more than **$2 million** in research funding that is directly applicable to management, propagation and conservation of rhinos under protection and management in the wild.

During our last research grant cycle, we awarded $262,326 for eleven rhino research grants, including five grants to graduate students, which fell within six target areas, including:

- Improving rhino population monitoring and/or tracking;
- Economic analysis of rhino conservation;
- Determination of the conservation value of different rhino populations;
- A desk study on the Sumatran rhino captures in the 1980s and 1990s; and
- Investigating factors affecting health, well-being and reproduction *ex situ*.

© Jesse Jeune | courtesy of Nicholas Harvey

These target areas were identified by international rhino conservation practitioners as the greatest need in the field. $50,000 of this funding was generously bequeathed from Mark Hopkins Schell.

HIGHLIGHTS FROM THE LATEST RESEARCH CYCLE

In South Africa, scientists examined how capture and translocation physiologically affects black rhinos and whether there are physical changes or stress responses for the animals. The findings have been immediately integrated into some capture and translocation practices in the field in order to reduce disease or injury and to improve the animals' success in their new habitat.

In Zambia, conservationists are working with international partners in three protected areas to refine a new rhino tracking system that uses a transmitter implanted in rhinos' horns. Once perfected, this monitoring system will allow for park managers to track rhinos' movement patterns and interactions. This critical information ensures the rhinos' safety and health.

The Rhino Research Center reviewed the Sumatran rhino capture and translocation operations in the 1980's and 1990's to develop recommendations for capture in the Sumatran Rhino Rescue project.

Researchers from Taronga Conservation Society Australia and the University of Sydney determined safe and efficacious dose rates for several NSAIDs (non-steroidal, anti-inflammatory drugs) in black rhinos.

At the Smithsonian Conservation Biology Institute, scientists explored how southern black rhinos' gut microbiota are affected by *ex situ* management.

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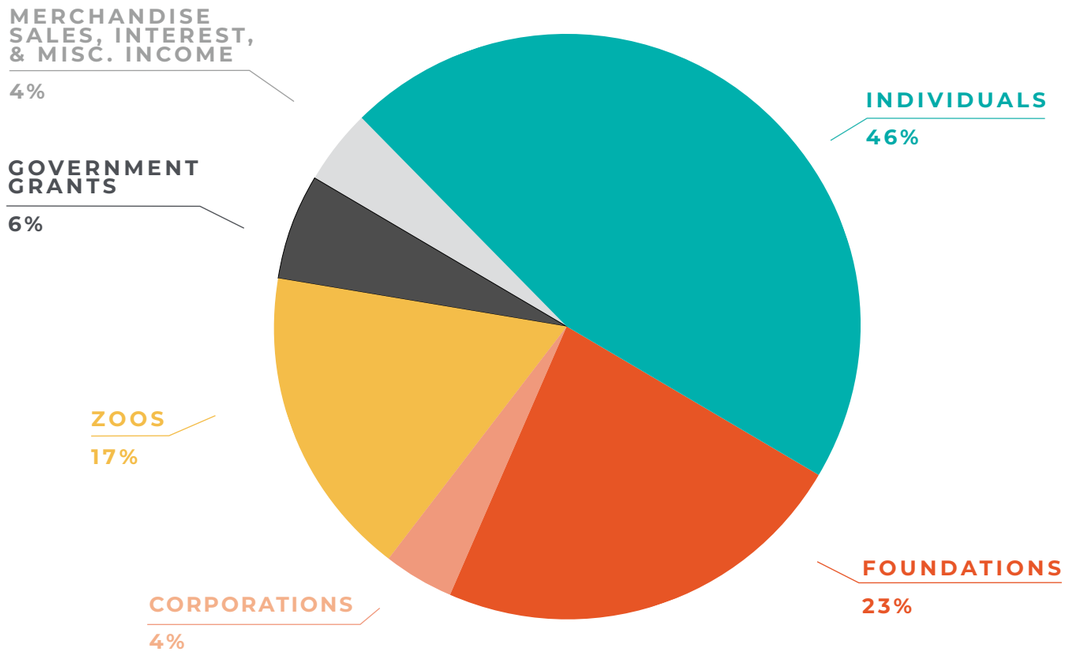
2021 REVENUE

INDIVIDUALS	**$1,369,322**
FOUNDATIONS	**$685,367**
CORPORATIONS	**$123,214**
ZOOS	**$509,816**
GOVERNMENT GRANTS	**$168,474**
TOTAL CONTRIBUTIONS	$2,856,193
MERCHANDISE SALES, NET	$9,214
INTEREST & MISC. INCOME	$110,206
TOTAL REVENUE	**$2,975,613**



2021 EXPENSES

AFRICAN RHINO CONSERVATION	**$648,272**
INDIA & NEPAL RHINO CONSERVATION	**$179,495**
INDONESIAN RHINO CONSERVATION	**$2,008,936**
RESEARCH & TECHNICAL SUPPORT	**$11,500**
TOTAL PROGRAM EXPENSES	$2,848,203
MANAGEMENT	$274,672
COMMUNICATIONS	$207,209
FUNDRAISING	$299,504
TOTAL ANNUAL EXPENSES	**$3,629,588**

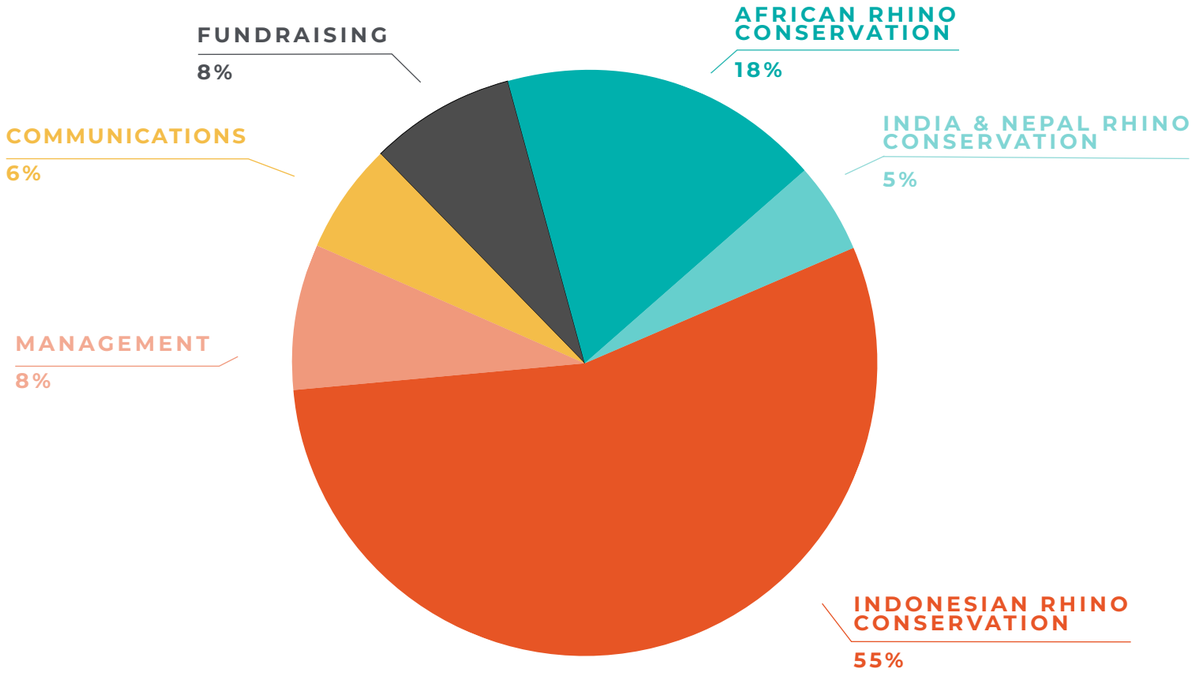


photo by Nico van Strien | International Rhino Foundation

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Action for Cheetahs in Kenya: Emerging Threats to Cheetahs

Mary Wykstra, Founder and Director

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Email: mary.wykstra@actionforcheetahs.org

PRESENTATION ABSTRACT

Action for Cheetahs in Kenya (ACK) has received AAZK Bowling for Rhinos funds since 2010. While field site activities in Samburu received the bulk of the funds, National Survey projects have been made possible thanks to the boost of funds provided. In 2021, Kenya remained with travel and connectivity restrictions through most of the year. Support from overseas was drastically reduced, but BFR and Cheetah Conservation Fund resources enabled us to maintain a staff of more than 20 Kenyans and to support pilot studies for the National Cheetah Survey. We revived community awareness programs through small groups and outdoor activities. Our field officers and detection dog teams increased activities in cheetah monitoring and connectivity data processing. Students from 2019 completed their analysis online with their professors resulting in three thesis papers and four manuscript publications. We also assisted our partners at CCF with design and care of cheetah cubs confiscated in Somaliland. We are optimistic about our partnerships as we move into 2022 with vitality and passion.

Background

AAZK Bowling for Rhinos initiated its support for Action for Cheetahs in Kenya (ACK) in 2010 and, to date, has provided over $320,000 of support to ACK. The support assists primarily with development of our field site and activities in Samburu, and National Survey projects. Carnivores Livelihoods and Landscapes (CaLL) is registered as a Company Limited by Guarantee (LCC) in Kenya and is a 501c3 organization in the US. ACK and COOL Crafts is a part of a team of in-country collaborations linked under the CaLL umbrella.

ACK worked closely with Cheetah Conservation Fund, Kenya Wildlife Service and the University of Nairobi to develop a strong foundation through which science-based decisions can be made. In 2017, the Mara Meru Cheetah project joined CaLL. Together we aim *to link carnivore projects to strengthen efforts in carnivore conservation in human influenced ecosystems across Kenya* (CaLL Mission). In 2019, we partnered with Samburu County, Ewaso Lions, Vet in Wild, the Animal Care Center and TNR trust to add One-Health initiatives in domestic animal disease and population management into our agenda. In 2021 and 2022, we strengthened the above relationships by including the Wildlife Research and Training Institute (WRTI (research arm of KWS), Jomo Kenyatta University of Agriculture and Technology (Kenya), Colorado State University (USA), the University of Salzburg (Austria) and the Hochschule Karlsruhe University of Applied Sciences (Germany) to not

Year	Amount
2010	$7,650
2011	$7,313
2012	$9,201
2013	$13,707
2014	$19,138
2015	$44,363
2016	$45,517
2017	$45,571
2018	$46,168
2019	$45,388
2020	$17,379
2021	$22,060

Figure 1: Twelve years of support totaling over $320,00.

only implement our National cheetah Survey (2022-2024), but also to assure we are able to link resulting data into an international geo-data base for cheetah genetics and to combat of illegal trade of cheetah cubs. It is essential in curbing the trade of cheetahs that we are able to locate source populations and quickly prosecute offenders.

We are a grass roots program that is focused on cheetah (*Acinonyx jubatus*) survival in human dominated ecosystems. Through research and community involvement we are impacting people's attitudes and contributing to conservation management. Our long-term pilot studies have collected data on the wildlife and landscapes for 20 years, making us the longest cheetah focused project in Kenya. In partnership with the Cheetah Conservation Fund, we have been assisting in planning and care for cheetah cubs confiscated in Somaliland while also remaining focused on the survival of intact cheetah populations in Kenya.

Previously Identified and Emerging Threats

In the 2010 Kenya strategy for cheetah and wild dog, Land-use change and human-wildlife conflict were identified as the greatest threat to cheetah survival. These threats fragment vulnerable pockets of cheetah populations (KWS, 2010). The cheetah is a cryptic large carnivore that occupies large geographic ranges. Cheetahs face range-wide population declines at a rate of 2.1% annually (Durant, 2017). In recent years new threats have fast emerged to challenge our role in cheetah conservation efforts. Within Kenya, the cheetah population is estimated to be less than 1,200 individuals with patchy ranges. The vast majority (75%) lives outside of protected areas (KWS, 2010).

Climate change, linear development and Illegal trafficking are fast emerging as a top threats to cheetahs on a range wide scale. Climate change affects cheetahs by increasing conflict over resources and increasing the impacts of human-carnivore conflict (HCC) that often result in cheetah mortality. Severe droughts in northern Kenya are having huge impact on lives of people, livestock and wildlife. Infrastructure development reduces movement of wildlife populations while at the same time also increasing demands on ecosystem services. When people become sedentary in a land that has traditionally been nomadic, these changes also increase HCC. Pocketed populations of wildlife are prone to disease and issues related to density dependence. It is currently thought that cheetah trafficking originates in the Horn of Africa (e.g. Kenya, Somalia, Somaliland, etc.; Alberts, 2020) before individual animals are brought to high-demand markets in the Middle East and Asia. As of April 2022, more than 100 illegally trafficked cheetah cubs have been seized in Somaliland; the cubs' countries of origin are theorized but remain officially unknown. Efforts to halt illegal trade is stifled by limited knowledge about the geographic source of trafficked cheetahs. Strategies for care, rehabilitation and possible release of confiscated cheetahs require greater knowledge about the processes underlying these illegal activities. Ultimately, illegal cheetah trafficking and trade cannot be mitigated, or even accurately discussed, if its sources and processes are unknown; nor can affects of climate change and linear development.

Frequent, large-scale movement of cheetahs makes it difficult to monitor and differentiate between individuals and populations. There are still significant knowledge gaps regarding general species presence and population estimates, contributing to knowledge gaps regarding

where and *when* cheetahs are trafficked. It is also extremely important that we build our knowledge of both the habitat and the prey base that supports a sustainable cheetah population.



Photos by ACK: Cheetah cubs confiscated in Somaliland (left); Cheetah in Samburu National Reserve, Kenya (middle); Dikdik – a common prey for cheetah throughout Kenya (right)

Solutions through Cheetah monitoring and Community programs

For the past 50 years, dedicated in-situ and ex-situ research has provided us with a strong understanding of cheetah behavior, reproduction and health. Projects in South Africa, Namibia, Botswana and Tanzania, and research through captive facilities and breeding programs, give us information to understand the cheetahs needs in conservation. It is critical to comprehensively survey the national cheetah population, educate local communities with information about the conservation value of cheetahs, and spearhead the fight against cheetah trafficking on local and national levels.

Pilot studies in cheetah monitoring include the use of local staff trained to conduct pilot studies on occupancy (Massiloux, 2018), conflict mitigation (Wanjira, 2021) and environmental caretaking. We found that patrol and transect data are not enough to understand the threats or solutions to populations of cryptic predators like the cheetah (Masseloux, 2018). On a national scale, the first range-wide cheetah survey left us with gaps in population knowledge that we have addressed in methodology for the second survey. Pilot studies using scat detection dogs in conservancies and protected areas produced a 97% accuracy in provision of samples that are used to genetically look at the links in populations (Mutoro, 2021). This information is also valuable in forensic science which can not only identify source populations, but through training of local authorities can assist in prosecution of the cartel responsible for the trade. Additionally, Mutoro et al (2022) completed a publication which stresses the need for prey biodiversity in the sustainability of cheetah populations and compliments the niche analysis conducted by Kuloba, et al (2015).

The Ginger's Hope vaccination and sterilization campaign was partially conducted prior to, but also during the pandemic. We joined forces with the Samburu county veterinary department, The University of Nairobi Zoonotic Disease Unit and local partners and veterinarians to reach a greater portion of Samburu County (Lekenit, 2021). The one-health vision of sustainability approaches environmental, animal and human health together to assure all remain healthy. We have implemented monitoring studies to confirm the mass campaigns are reaching an adequate percentage of the domestic animal population and to determine if there are varieties of distemper which are unique to the region. Through grants to Ewaso Lions, the first mobile veterinary unit in the region was launched in 2021 to help communities with the health and care of domestic pets and to work with the county on population management.

Conflict mitigation is an important element of conservation of predators. In 2022, we completed a training session with 30 participants from different regions of Kenya to review our Conflict Mitigation Toolbox. The final edits of the book will be completed at the end of this year and distribution of the Toolbox will be initiated. Additionally, following four consecutive studies on deterrent lights, the students have linked to write a series of publications about the effectiveness of the lighting systems. The lights like any other mitigation system rely heavily on healthy livestock management and attentiveness. The lights are a useful tool in the nomadic lifestyle and can be utilized in both permanent and temporary livestock enclosures. Two publications will be completed in 2022 and 2023 respectively.

We initiated new outreach programs in the Samburu communities through herder classes, conflict Mitigation, our Takataka solid waste management projects and through hosting the first International Cheetah Day sports tournament in the area. These events were overwhelmingly welcomed. Throughout 2022, we have conducted strategic planning to look at the ways that we can scale up Ginger's Hope, Takataka and the Champions for Cheetahs sports events to assure that the projects utilize the knowledge coming in and create fun ways to engage the community in strong conservation initiatives.

While the biological research side of conservation is important for decision making and project implementation, it is the community tolerance and understanding of predators that allows cheetahs to survive in the wild for future generations. ACK programs include ecological and biological studies of the cheetah in its environment, but we also study the relationship of cheetahs and people. We seek solutions for improved livelihoods through natural resource management, improved and alternative livelihood enterprises and capacity building.

Photos by ACK: 4000 domestic pets vaccinated in Samburu with partners (left); Ranger trainings were followed by six months of practical use to assure our mitigation toolbox was easy to use for all levels of literacy (middle-left); Flashing deterrent lights tested by four students (middle-right);

BFR Support

The focus of BFR support has been in development of the Samburu field location and more recently in partially supporting the National Cheetah Survey. Our Samburu field site was opened with five tents, an office, kitchen and storage facilities. Now that our full field operations have shifted to northern Kenya, we have outgrown our site and frequently set up temporary tents to house our growing staff and incoming students and volunteers. We have initiated a task force to look at the options of expansion for our facility to support at least 10 full time research, outreach

and canine team staff. We have strengthened our partnerships to develop a shared genetic data base which will aid in the international issue of cheetah trade. We are revisiting the need for a cheetah care and rehabilitation center which would include long term detection dog training and care facilities along side of mentorship for local and international student accommodations and laboratory facilities.

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How AAZK chapters are changing the game and branching out with new events.

Matt Mills
Bowling for Rhinos Program, Vice Manager

We all know bowling and rhinos go together like peanut butter and jelly, but in some parts of the country, planning a bowling event can be difficult or costly. As bowling becomes a less popular hobby, many bowling alleys are closing their doors. The ones that remain can be difficult to book; they want to keep their lanes available to leagues and raise the price for non-league events. We've seen an increase in non-bowling events over the last decade and that trend was accelerated during the first two years of the pandemic. The Bowling for Rhinos team reached out to several chapters to find out what pushed them to look at other options, what inspired their creative departure, and how they accomplished it. We hope this overview will encourage experienced chapters to try something new and motivate new chapters to join BFR.

Bingo – Saint Louis Chapter, Courtesy of Jeremy Martin

The Saint Louis Chapter held their inaugural bingo event, which is possibly the first BFR bingo event. They were apprehensive about changing the format, but wanted to hold a COVID - friendly event that pushed their chapter in a new direction. It was important for the chapter to hold an event in an open air venue, so they partnered with the Saint Louis Zoo to hold the event in a large open tent and kept attendance lower than the tent's capacity.

They also moved their auction to an online format and utilized Eventgroove Fundraising to host it. The move created the "opportunity for people to participate from home if they didn't feel comfortable attending in person" and "helped push bids because there were text notifications if you were outbid". The auction was very successful even though there were fewer items than they traditionally offer.

Saint Louis cautions that the most time-consuming aspect of event planning was getting a gambling license, which is required through the state of Missouri since bingo is a game of chance. They note that receiving the license required "background checks on the event planners, banking information from our chapter, and other paperwork." Not all states require this type of license for bingo, so you'll want to check with your state's gambling authority at the start of your planning process. They decided to apply for their own license rather than go through a private company because it was cost effective and easy to re-apply for in the future.

Saint Louis adds that they had great reviews from attendees, people enjoyed the novelty, and believe that they attracted a different crowd because some people "get shy about not being good at bowling".

Brewery Partnership – Badger Chapter, Courtesy of Ellen Vossekuil and Kristin Myers

The Badger Chapter of Wisconsin is a very new chapter, but jumped into the BFR community in only their third year of existence. Planning their first BFR event at the start of the pandemic "really cramped our style as far as large in-person gatherings. We knew we wanted to participate in BFR, but a traditional bowling event just wasn't going to be successful". Through a chapter member, Badger AAZK had a connection to a seasonal outdoor beer garden which donated a portion of the night's sales to the chapter. Fortune was on Badger's side the night of the event "even though the event was held on a Wednesday, the Biergarten was at capacity. Only a very small number of patrons were there specifically for our event; the rest of the patrons were just regular customers. This was a fantastic opportunity to not only raise money for rhinos, but also introduce community members to our chapter!" Biergarten cashiers gave the chapter a big assist by asking patrons if they would like to make an additional donation to the BFR event.

In addition to a percentage of sales and donations, Badger was able to raise funds through merchandise and a raffle that included a behind the scenes tour at the rhino building and a specialty bike donated by a local brewery. They also sold handmade "rhino-specific stickers, coasters, buttons, bags, and art mandalas". Badger says that aside from merchandise "the pre-event planning was relatively simple compared to the amount of money we were able to raise. Because of our established partnership with this business, we decided to hold another event in 2022 at the same location."

Bowling Pin Decoration – Point Defiance Chapter, Courtesy of Russell Pharr

The Point Defiance Chapter has had great success by upcycling used bowling pins into art. The idea came to event chair Russell when he found an old pin painted to look like a bald eagle. The chapter learned that "pins don't have long life spans, and bowling alleys are usually happy to give away as many pins as you are willing to take". Aspiring artists paid a small fee to decorate each pin and the pins were put on display at the zoo once completed. The chapter held a "community voting contest, which has been a great way to engage the whole zoo in BFR." After the voting closed, the best pins were put into the chapters' BFR silent auction, which "raises even more money for rhino conservation, and makes for some one-of-a-kind auction items!"

Point Defiance says "the results have been really phenomenal - we have seen bowling pins transformed into everything from mermaids and cartoon characters to fully functioning lamps and miniature race cars - along with, of course, a dazzling array of animal designs." Point

Defiance had been planning on incorporating the pin decoration into their event prior to COVID, but it "ended up being a great solution to engage our community with a social distancing-appropriate celebration of BFR". While particularly well suited for traditional bowling events, this inexpensive project compliments nearly any type of event you want to hold and as a stand alone fundraiser.

Concert Series – Nashville Chapter, Courtesy of Jason Faessler

Being located in "Music City", the Nashville Chapter had the unique opportunity to create an event that reflected the city's connection to music. The chapter created Rockin' for Rhinos after they "connected with a group of young professionals that contained several people with music business backgrounds. We also partnered with a popular local independent radio station for promotion and credibility." The goal was to "gather passionate people from all aspects of the music industry and make this an annual event in Nashville." After taking the time to learn the ins and outs of the music business, the chapter was able to hold their first "Rockin' for Rhinos" event in 2016 and hosted four bands. The show was a success, but the crowd was mostly zoo staff and friends and family of the bands, the chapter "really wanted to market and promote the show to bring in the general public….to be truly successful, we wanted this event to be fun and also get the public excited about saving rhinos."

In 2019 the chapter started an intimate acoustic event called "Writers for Rhinos", held at the zoo amphitheater. At this event, four or five song writers would be on stage together, each would "play a song, talk a little bit about the song's origins, or the artist they wrote for". The chapter "brought in lights, a professional sound system, banners, and bars with donated wine and beer … everything you would want for a top-notch show. It was a resounding success! It turns out that when you have Grammy nominated talent, the show sells itself!" The next time they held Writers for Rhinos they moved the event from the zoo to a popular venue in downtown Nashville that had food service and a bar, while they "lost the charm of hosting at the zoo" they also cut "99% percent of the logistics and setup." Nashville AAZK says that even though it was a lot of work in the beginning to build the knowledge and network, it was well worth it. After a few years they "had so many connections in the music industry who were passionate about our mission that the show was basically put together with very little footwork from AAZK members." Nashville held their third Writers for Rhinos in April, will hold their fourth Rockin' for Rhinos this summer, and are looking to add an additional Writers for Rhinos this fall.

Virtual 5K – Greater Houston Chapter, Courtesy of Kendall Thawley and Amie Bialo

Before COVID hit, the Greater Houston Chapter was already facing a problem many chapters have had to deal with, the local bowling alley that had hosted their events for years had shut down and the next closest one was a long drive away. Between looking for a new venue and "lockdowns, economic turmoil, and toilet paper hoarding we knew that we needed to drastically

alter our usual plans. A Virtual 5K seemed like a good fit for us." Greater Houston held this event two years in a row. The first year they used RunSignUp, an events platform geared towards runners, and the second year they used Ticket Tailor, a general, but easy to use and low fee online ticket seller. They used Ticket Tailor the second year because it was not important to them if people actually ran the race, they just needed a way to process payments and organize participants.

Event registration included a shirt, but Greater Houston suggests giving participants the option to opt out of the shirt or charge more for those that do want a shirt. The first year of the event, they printed the shirts through Custom Ink, had them delivered to a chapter member's house, then hand delivered shirts to locals and mailed the rest. This was extremely time consuming and not recommended. They tried Bonfire the second year, but ran into issues when Bonfire "changed shirt pricing during the middle of the campaign" which drastically altered the event's profit margin. Additionally, the chapter had a customer service issue that the support team was slow to respond to.

Greater Houston combined their virtual 5Ks with a virtual raffle, virtual silent auction, and a book sale. They recommend this event type because "everyone could participate in their own time and at their own pace, and allow for social distancing by doing an outdoor activity. It also didn't rely on having an event space, so it drastically decreased our overhead costs and meant that people from all over could support our event, not just locals. Overall, we had a great response to the new event!"

Virtual 5K – Greater Orlando Chapter, Courtesy of Melaina Kincaid

Due to state restrictions caused by the pandemic, the Greater Orlando Chapter knew they would not be able to hold a bowling event and instead held a virtual 5K, believing people would want to get out in nature more and to encourage everyone to socially distance themselves. They advertised their event through social media as well as email.

Orlando was able to keep costs down in three unique ways:

First, they didn't use a race registration company, but instead had registration go through their website and created a google doc to organize registration. This is a great idea if your chapter has access to its own website and can process payments through it.

Second, they kept swag bags minimal as "a way to keep the event environmentally friendly" and keep costs to a minimum. A local member created and donated decals for the swag bags.

Third, the race medals were “created by an art professor, giving them a unique touch compared to other race medals. The medals were wooden which provided a more cost-friendly alternative to metal”. Greater Orlando highly recommends contacting local schools’ “art department or metals department to ask if a student would like to do this as a project”.

Greater Orlando warns that they did have some unexpected costs. They had many overseas registrants and mailing the swag bags to them got expensive. In 2022 they plan on charging a higher shipping rate for overseas participants and will seek out “sponsors for the event to cover the cost of the medals, lanyards, bags, etc. so that 100% of race registration could go to BFR.”

Sailing for Rhinos - Dallas AAZK Chapter, Courtesy of Linda King

The Dallas Chapter has been an active participant in Bowling for Rhinos from the very early days and since 2002 has been holding two fundraising events each year. In addition to the traditional bowling event, they also host the one-of-a-kind “Sailing for Rhinos”. It started when the zoo’s Deputy Director of Operations approached the chapter about unique ways to improve staff and volunteer involvement while increasing awareness of the chapter's fundraising efforts. “She asked if offering sailboat rides on our local White Rock Lake would be popular? The answer from the officers was a resounding “yes”!”

The chapter formed a relationship with the Corinthian’s Sailing Club. The event is held on a warm evening in May and, in addition to the picnic dinner and silent auction, attendees are treated to sunset sails generously donated to the event by the club's members. Sailing for Rhinos “became one of our most popular events. It has grown from ~100 participants to a high of 230”. The event is held at the sailing club's dock and clubhouse, which has a maximum capacity of 250 people.

After 2020, the Dallas Chapter began looking at fundraisers they could safely host. Sailing for Rhinos was “the first event our Dallas Zoo leadership felt comfortable supporting”. The chapter did have to make some adjustments. They scaled back the food from a full picnic to bite-sized appetizers and limited attendance to 125 people to comply with the sailing club’s requirements. But in 2022 the “event has returned to including a full cookout dinner, beverages, sailing, t-shirt sales and silent auction”. They keep the price of attendance reasonable: $20 adults, $10 kids, free for three years and under, and the price increases $10 at the door to encourage presale. They also seek sponsors for the event, which range from $500 to $100 or the donation of an auction item. In return for their sponsorship, businesses get their information prominently displayed on the Dallas Chapter’s website, Facebook page, by auction items, as well as tickets to the event. 2022 is the 20th anniversary of Sailing For Rhinos and the Dallas Chapter looks forward to

“celebrating our ongoing partnership with the amazing members of the Corinthians Sailing Club, our sponsors, chapter members and Dallas Zoo family.”

Thank you from the BFR Team

As you can see from the preceding examples, necessity is the mother of invention. As the world changes, it is important that we learn from each other and adapt our events to flourish with new challenges. Whether it’s because of chapter size, local economic conditions, or a worldwide pandemic, holding a large bowling event isn’t feasible for every chapter. However, every chapter can still protect rhinos, their habitat, other species in their ecosystem and help support communities in Indonesia and Kenya by participating in BFR. We’d like to thank the Badger, Dallas, Greater Houston, Nashville, Greater Orlando, Point Defiance, and Saint Louis chapters for eagerly sharing details and images of their events so that all chapters can learn and be inspired by our communities efforts to protect wildlife.

As always, if you have any questions about Bowling For Rhinos, please reach out to the BFR team at BFR@AAZK.org.

The History of "Trees for You and Me" and How You Can Be Part of It!

Cindy Roberts
Conference Liaison, Trees for You and Me
Tacoma, Washington

What is "Trees for You and Me" (TFYM)? It is a grant program that supports global reforestation efforts through funds raised by American Association of Zookeepers (AAZK) Chapters. In 2009, the idea came to Columbus Zookeeper, Alicia Shelley, a Polar Bears International (PBI) Field Ambassador. This concept fueled the passion for polar bears in another PBI Field Ambassador, Christy Mazrimas-Ott Christy took the idea, with the help of AAZK President Shane Good, to AAZK and ran with it to make it the successful conservation effort that is today. With the support from AAZK and PBI, TFYM has evolved and grown over the last thirteen years to make a big impact not only for polar bears but many other species all over the world.

The concept of TFYM was that planting trees is essential for helping to absorb carbon dioxide (CO^2). Excess carbon dioxide creates a heat trapping blanket around the earth and traps heat, causing rising temperatures that impacts sea ice loss, which is a polar bear's hunting platform and is essential to their survival. Christy, the Chair of TFYM, with the help of PBI, took this idea to the Arbor Day Foundation and formed a partnership to start planting trees and raising money to combat climate change for polar bears. As TFYM moved forward with coordinating their annual event, they added an element of competition between AAZK Chapters. It was a fun way to promote the event and add an incentive for bragging rights and a great prize.

Where does the money raised for TFYM go? The first three years of the fundraising were such a huge success raising **$52,127.61** and allowing for over **10,380** trees to be planted to combat climate change. With **ninety-two** AAZK chapters coordinating their own events the program moved in a new and exciting direction. On TFYM's 4th anniversary, changes were made to give local AAZK chapters participating in the fundraisers more flexibility and opportunities to raise funds for the organizations of their choosing. Chapters could choose to donate to any tree/forest organization or they could choose to donate and use the funds to plant trees in their local communities. This opened so many opportunities for AAZK Chapters to get on board with this cause!

Over the 13-year span, from 2009 to present, TFYM has grown and expanded their program to plant trees, raise money and combat deforestation through many different organizations, in local communities, and all over the world. From 2010 through 2016 all proceeds went to planting trees and for parks and forests. In 2017 the funds raised transitioned to going to the newly founded "AAZK Trees for You and Me Grant." The program worked hard and inspired so many chapters who all together helped raise almost **$185,000.00** and planted thousands of trees all to protect polar bears and other species around the world. It only takes a small step for you to join our cause!

Are you and your local AAZK Chapter interested in raising money for TFYM? There are so many ways that you can coordinate fundraisers, big or small. From bake sales, garage sales, dunk tanks to silent auctions or even large-scale events. In 2022, Columbus Zoo held their first annual "Party for Polar Bears!" after being inspired by the annual event that was founded in 2015 by the Point Defiance Zoo & Aquarium AAZK. Columbus AAZK had a family-friendly fundraiser that was held at Nocterra Brewing Co. in Ohio. They had a raffle and visits from ambassador animals and Polly the Polar Bear mascot. Not only did this help to promote local businesses, but they raised almost $1900 for TFYM! They had an overwhelming turnout, tons of fun, and hope to make this a yearly fundraiser. Whether your fundraiser is big or small, every event helps to get the word out about TFYM and helps us to plant trees and mitigate climate change.

Starting a fundraiser is not as hard as it seems. Fundraisers can be held during the TFYM campaign running from February 1st through November 1st of each year. Additionally, you can plan an event on any of PBI's actions days including:

International Polar Bear Day- February 27th
Earth day- April 22nd
Arctic Sea Ice Day-July 15th
Polar Bear Week-first seven days in November

We are here to support coordinating your fundraisers! Contact TFYM via email TFYM@aazk.org with questions or help getting started. If you would like to make a direct donation to TFYM go to https://aazk.org/committee/trees-for-you-and-me/tyfym-donation/.

A member of your AAZK Chapter might have a chance to go to the Arctic! "TREEBLITZ" is an incentive campaign sponsored by PBI to show their gratitude to AAZK Chapters for helping to raise money to plant trees and save polar bears. PBI offers one spot in their Climate Alliance Program (when available), for a nominated AAZK member, who would travel to Churchill, Manitoba, "the Polar Bear Capital of the World" in Canada. On this seven-day adventure they will learn all about polar bears, the history of Churchill, the culture of the people of the North and learn specific methods of how to teach people in their communities about climate change and the impact on polar bears. In addition to this incredible opportunity, they would get to experience firsthand the Arctic, observing wild Arctic species, including polar bears, while riding out on the Tundra Buggy provided by Frontiers North Adventures.

To be eligible for the drawing AAZK Chapters are invited to donate to TFYM February 1 through November 1st. To increase their chances during "TREEBLITZ" from February 1st through April 1st, for every $100.00 donated, the AAZK chapter will receive **TWO** raffle tickets up to $500.00. That doubles the tickets from 5 ticket to 10 ticket per chapter. Once the winning AAZK Chapter is chosen (by randomized drawing), they will then nominate a member from that chapter to go to the Climate Alliance in October of the next year (dates are subject to change per coordination with PBI). Start planning your fundraisers now and you may have the excursion of your life with PBI and zookeepers from all over the world!

You or your favorite organization can apply for the AAZK "Trees for You and Me Grant." The goal of this grant, which was established in 2016, is to provide funds to qualified US or international non-profit organizations that will utilize the funds to mitigate climate change through habitat restoration. Any organization with a project to combat deforestation or climate change is invited to apply. Applications are due by November 15th of each year and will be reviewed by the TFYM committee with the Grant Committee making the final selections. Funds to chosen organizations will be funded by the end of each calendar year. The first ever recipients of the TFYM grant were given to Akron Zoo Cans for Corridors, planting 1,706 trees and Lake Louisa State Park in Florida, planting 800 plants. You and your favorite organization can apply for a grant, or you can help raise funds to support these grants! Help combat climate change, protect polar bears and other species all over the world! Go to https://aazk.org/committee/trees-for-you-and-me/ for more information.

TFYM has a long and inspiring history of raising money for polar bears and mitigating climate change. In the last thirteen years TFYM has raised almost **$185,000.00** to help support reforestation, education, fundraising and combating climate change to protect polar bears and many other species all over the world. You and your AAZK chapter can help TFYM and to continue the great work that they do. Whether you organize fundraisers, plant trees, or apply for a TFYM grant for your favorite non-profit, you can help make a difference. When you join TFYM in their efforts not only are you helping to combat climate change for polar bears but also for many other species whose habitat is being impacted by our warming earth. We can all make a difference for many generations to come!

TFYM Funds Raised and Trees Planted

2010- $10,529.00 raised by 26 AAZK Chapters, 120 trees planted in Okaloacoochie State Forest, FL; 3,401 trees planted Boys Colony State Forest, AL; 6,866 trees planted in Mackinaw State Forest, MI
2011- $15,302.70 raised by 29 AAZK Chapters, trees planted in Kettle Moraine Forest; city of Sparta, WI; and the Juneau County Forest
2012- $26,325.91 raised by 37 AAZK Chapters, trees planted in Florence County Forest; the City of Sparta, WI and in Merrill, WI.
2013- $10,748.10 raised by 15 AAZK Chapters
2014- $6,692.45, raised by 11 AAZK Chapters
2015- $9,943.00, raised by 12 AAZK Chapters
2016- $13,837.92 plus $500 PBI matched donation = $14,337.92, raised by 15 Chapter

TFYM Grant Recipients:
2017, $18,364.45, NJ Simms, planted 25 trees and The Wilds, planted 1090 trees
2018, $20,392.37, Red PanTreda Network, Save the Golden Lion Tamarins, plated 12,00 trees between both organizations
2019 $14,562.69, Vital Ground Foundation, planted 250 trees and 2,000 shrubs and National Forest Foundation, planted 221,000 seedlings
2020, $5800.67, International Rhino Foundation, planted thousands of seedlings
2021, $15,000.00 Painted Dog Research Trust, planted for Forest and Elephants for Africa and $2360.62 used to train communities to grow seedlings that will be purchased by the EFA

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A Mask Fit for a Princess

Megan Pushie, Senior Keeper
Utah's Hogle Zoo
Salt Lake City, UT

When caring for animals, you often have to think outside the box. With some modifications, some things that work well for domestic animals could also work well for the animals in your care. That's why, in 2017, the Elephant and Rhino team at Utah's Hogle Zoo started a partnership with Horseware Ireland® to come up with a solution for geriatric Southern white rhino (*Ceratotherium simum simum*), "Princess". "Princess" experiences seasonal allergies, which present as watery and swollen eyes. Flies can cause additional irritation as well as transmit unwanted bacteria, so the animal care staff thought a fly mask, similar to those used on horses, could work well for "Princess". The keepers reached out to a local equine supply company, and they connected us with their partner, Horseware Ireland®. Measurements were taken of "Princess's" head, and prototype masks were made. For the next eight months, keepers trained "Princess" to station her head in a specific spot to safely enable trainers to put the mask on, desensitize her to the sensation of cloth on her face, and ultimately, where "Princess" would wear the mask comfortably. Training also had to accommodate for her herdmate, "George", working to desensitize him to the presence of the mask as well. Through much trial and error, this has become a very successful preventative for "Princess's" allergies during the summer months over the past five years. Utah's Hogle Zoo continues to have a great partnership with Horseware Ireland®, who generously created and donated the masks for "Princess" in hopes of sharing and benefiting other species.

"Princess" and her sibling "George" have lived at Utah's Hogle Zoo since the late 1970s. Their current habitat is located in the central part of the Zoo, it is about a quarter of an acre, with dirt covering the entirety of the habitat. A large mud wallow is located within the habitat. The perimeter fence is four heavy duty cables through large bollards, with about 2 feet between each cable. (Photo 1) The rhinos can also be housed within the Elephant Barn, which has four stalls total, with two stalls mainly for rhino use. The front of the stalls have mesh panel doors of differing sizes that can be opened from the outside by Animal Care Staff. (Photo 2) "Princess" and "George" have participated in a training program, as well as a guest encounter program, for many years. They are conditioned to take apples, oranges, and bananas from both keepers and guests, from a feed stick or by hand. These can take place either in the barn or outside by their habitat.

Photo 1

Photo 2

During the summer of 2016, keepers noticed that “Princess’s” eyes were watery, swollen, and sometimes would bleed, presumably from “Princess” rubbing her eyes on different things in her habitat. Flies were also causing irritation, and perhaps worsening her symptoms. Veterinary staff thought it might be an allergic reaction to something in the environment, and prescribed ointment and fly spray to be applied on and around her eyes. This seemed to help somewhat, but keepers wanted a better, more permanent solution for “Princess”. One of the keepers thought of a horse fly mask, and how that could be modified to fit on “Princess’s” head. That keeper then reached out to a local horse ware company, who then was able to put the team in contact with a company called Horseware Ireland®.

Horseware Ireland® agreed to make a prototype mask for “Princess”. They would need measurements of her head, so keepers got to work. Since “Princess” knew how to target to a plastic, blue and white boat buoy, keepers were able to target her head through two bollards at the front of the stalls. Once positioned, keepers desensitized “Princess” to a soft measuring tape on and around her face, horns, and ears. The

measurements were sent to Horseware Ireland®, and the team waited for the mask to arrive. In the meantime, the keepers knew that “Princess” would need more desensitization to cloth on her face, so additional desensitization to that step was started. This started with a strip of cloth, and would drape it over the horn and other parts of the face. (Photo 3) The trainer would also put it over “Princess’s” eyes, and cue additional behaviors with the cloth hanging between her horns. The sound of Velcro® was also used to help desensitize “Princess” to how the mask would be secured.

Photo 3

Once the team received the mask in mid-summer 2017, training continued to progress. This mask was gray mesh on the bottom and gray fabric on top, but with bright pink trim. There were holes for the ears, and holes for both horns. (Photo 4) Rhinos do not have very good eyesight, so the team knew that it might take some time to get used to this large piece of fabric. The trainer started with having the folded mask next to “Princess” during training sessions, then would slowly unfold the mask as sessions went on. The trainer would also wear the mask during training sessions, to further help with desensitization. Once “Princess” had no reaction to the mask being around her, the mask was put onto her face in sections, slowly working up to putting the whole thing

over her face and ears. The team utilized the Elephant Restraint Device (ERD) for this. The ERD has doors on the East and West sides, and two doors in the middle that can be squeezed down. Both rhinos are used to entering the ERD, where the scale is housed and regular weights are obtained. The team used the ERD to put the mask on all the way for the first time for ease of access. “Princess” showed calm tolerance, good duration, and steady hold with the mask being on her face, so training progressed back in the stalls. Two keepers were required to put the mask on at first, one to feed “Princess”, and one to put the mask on and take it off.

Photo 4

It was also important to the team to have many options on where to put on and take off the mask. Because the elephant barn has hydraulic doors, staff were able to creep certain doors open wide enough for “Princess’s” head, and to practice the mechanics of putting on and taking off the mask through the doors. Staff also worked on putting the mask on and off in the outdoor exhibit through the cables.

While all of this training was happening with “Princess”, “George” was also going through desensitization with the mask. Staff thought that “George” might be startled or show aversion to the mask on “Princess’s” face and react adversely, so trainers wore the mask while training with “George”. “George” was never very comfortable with the mask being worn by trainers, but when “Princess” was wearing it, and “George” could see her through the mesh shift doors, he showed no reaction. A short, uneventful introduction was done with “Princess” wearing the mask. Since “George” did not react adversely, keepers decided it was time to see how “Princess” would do outside.

The first time “Princess” was given access outside with the mask on was to a small, off exhibit yard. The mesh on the mask is easy to see through, somewhat like looking through a screen door, but with rhino’s poor eyesight, the team was not sure how it would go. “Princess” was given access to the yard by herself, and had no trouble getting around and finding hay piles scattered throughout the yard. She was then given access to the main habitat for a short time. “Princess” did well navigating the habitat with the fly mask on. It was decided that she could wear the fly mask all day.

After some days wearing the mask, the keepers noticed that the bottom was a little too long, as it would drag on the ground, and make it a little difficult for “Princess” to eat and drink. The mask was modified by cutting the bottom hole off, and having it only go around the top horn. The modifications were sent to Horseware Ireland®, and they were able to make a few new masks with these modifications. (Photo 5) Over the years, the mask has gone through a few additional generations with help of some volunteers who sew. These volunteers are also able to repair the masks as needed when they get holes in them, or the Velcro® straps rip off. Horseware Ireland® has sent “Princess” new fly masks every year since 2017.

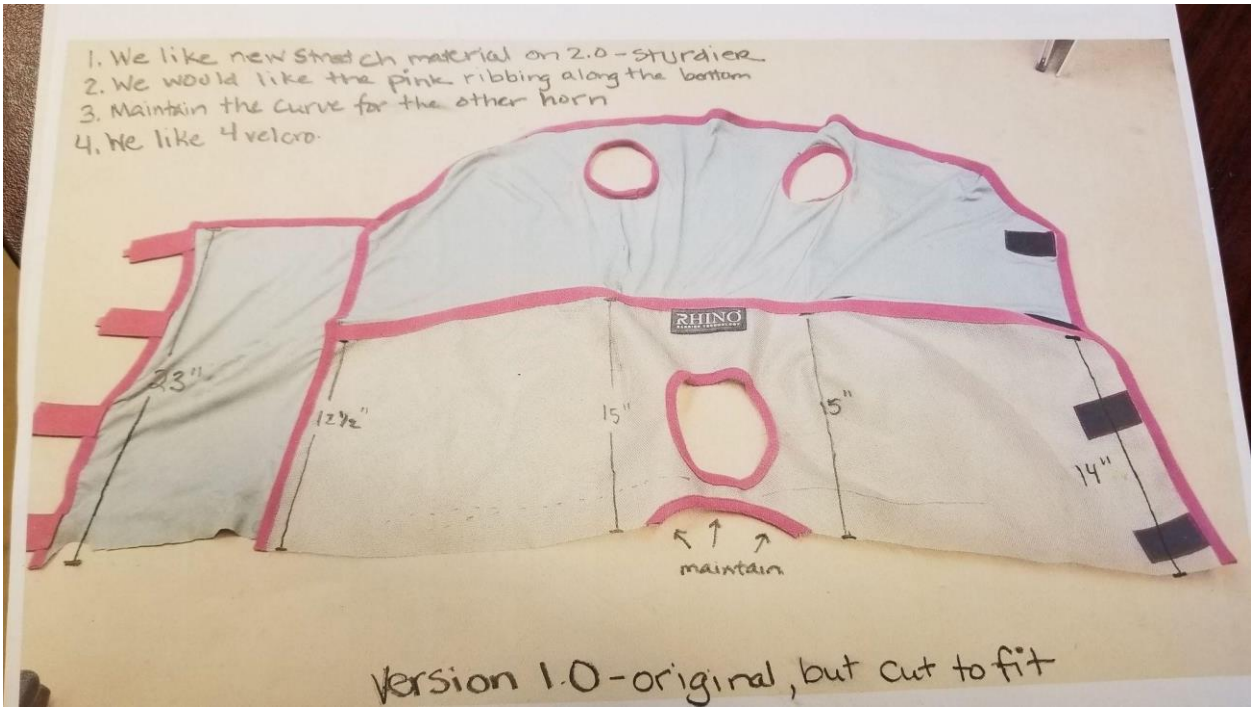


Photo 5

Over the summer, when overnight temperatures are warmer, the rhinos are able to stay in their habitat overnight. They are shifted inside in the morning for hay and a ration of Mazuri Hay Enhancer pellet. When “Princess” needs her fly mask on, keepers save the preferred pellets to help with putting on the mask. Keepers place the pellets in a tub on the outside of the stall, “Princess” positions her head between the bollards, and the mask is put on while she eats. The rhinos are then shifted back into the outdoor habitat for the day. Late shift keepers then take the mask off when they feed the rhinos their last ration of hay.

When “Princess” first went out with her fly mask on, an all staff email was sent out explaining the mask and communicate why she was wearing it. Signage was also utilized to inform the guests. Keepers are able to have many great conversations with guests about the fly mask, and how the team was able to train “Princess” to wear it. Keepers brainstormed a good idea to have a sample of the mesh section for guests to look at, since many people asked if “Princess” can see through it. Some sunglasses were repurposed from Lost and Found and were made into “Fly Mask Glasses”. The lenses were taken out and some of the mesh glued over the frames. (Photo 6) These are a huge hit with guests, especially children, as they are able to see what “Princess” sees.

Photo 6

The fly mask has greatly reduced the allergy symptoms throughout the summer months. “Princess” no longer needs ointment or fly spray applied around her eyes. “Princess” and her fly mask has even garnered some media attention via a few local news stories, and countless guest connections throughout the years. The Elephant and Rhino team at Utah’s Hogle Zoo and Horseware Ireland® hope to help other rhinos, or any other animal that has eye allergies, and have willingly shared this information with many facilities around the country. All of the training and modifications were well worth it, because “Princess” now has a better quality of life.

I would like to thank Melissa Farr, who had the original idea for the mask. Lisa Ellison, who is an amazing trainer and the primary trainer for the mask behavior. The rest of the Elephant team at Utah’s Hogle Zoo, who are always looking for ways to enhance the welfare for the animals in our care. Lastly, Horseware Ireland® who have been so generous and great to work with.

Boys in Stripes
Grevy's Zebra Bachelor Herd Formation and Management at the Toronto Zoo

Amanda Taylor, Keeper Grade 2, Institutional Representative: Grevy's Zebra
Toronto Zoo
Toronto, Ontario

Brent Huffman, Lead Keeper of Mammals
Toronto Zoo
Toronto, Ontario

The formed Grevy's Zebra (Equus Grevyi) bachelor group:
"Jake" (14.5 years), "Obi" (3 years), "Poe" (1.5 years)
Even though two are still young, it has not always been smooth sailing

The problem…
The Toronto Zoo had 2 male foals born over 2 years.
Foals unable to live with mares after 2 years of age.
Inability to house each male zebra solo.
Inability to castrate and house with mares.
Unable to ship males out to other facilities for a number of years.

TZ Zebra Locations

*Savanna exhibit (breeding group) ● ~ 1 acre ● Associated barn + yards
*Neighbouring savanna barn (males – winter)
*Off-exhibit summer paddock (males – summer) ● ~1/3 acre

Thankfully, at our facility we have options to house our zebra, but those options dwindle when winter comes around.
Having three separate options for our zebras was a very vital part in establishing this grouping, as we were able to keep the boys far away from our mares as possible during the warmer months.

An unusual bachelor herd beginning ...

1.0 Jake needed a friend..

*Strong stereotypical behaviours when housed by himself

*Bachelor herd was proposed to improve his quality of life

*In line with behavioural biology of species

Jake has been a challenging animal to manage since his arrival. He lived with other zebra within his first year, but when he was separated from them, we saw a big change in his behaviour. Without companionship, he displayed weaving and pacing behaviours that affect him mentally as well as the integrity of his hooves and confirmation. Through implementing more training, enrichment, living next to other species, mirrors and allowing him to live with mares for breeding, these behaviours subsided but never went away entirely. Our keepers hope that adding a permanent herdmate in the form of his son, would allow him to have constant companionship.

Bachelor dyad

*Jake + 1.0 Obi born Feb 2019

*Introduced 2.1 on exhibit during breeding introductions

*Then separated the two males off for the winter without incident

*Aggression in spring, but resolved when moved to summer paddock

Jake has been introduced to foals with mares present in the past. We anticipated a lot of chasing, and hopefully, having mom there would curb the chasing behaviour. Unfortunately, Tori didn't do much to help her son, and Jake chased Obi for about 30 minutes before things settled.

Once settled, the trio did well together with minimal chasing there on out, as Jake was preoccupied with breeding Tori. We also were informed by other facilities to introduce male foals to adult stallions when they are still small, so they do not pose a threat or competition. When the boys were separated off from Tori, we saw minimal issues over the late fall/winter with the two living harmoniously. The only issues we saw in spring was chasing from Jake, with an increase in wounds from mounting on Obi.

We were able to move the boys to a paddock much further away from the house where the mares live, eliminating the calling back and forth and smells from the mares thus reducing competitive behaviour from Jake.

And they lived happily ever after ...

Down in "outdoor holding", we saw complete reduction in aggression or competitive behaviour. Outdoor holding proved to be a great option for the boys without presence of mares, lots of grass, shade and the quiet of the rogue valley.

… and then came 1.0 Poe, born Dec 1, 2020
No movement on SSP recommended transfers
Adding him to the bachelor herd was the logical solution

Breeding between Tori and Jake proved successful! Poe was our newest addition, and while a new arrival is always exciting, a new boy proves to have its challenges. We made a plan when he was on the ground to introduce him to Jake and Obi before he gets "too big". The plan was to use outdoor holding as the intro space on account of the size, lack of mares, and no hot wire.

Step 2: Add Poe to existing group

● Timeline was a balance between age (post-weaning) and season (pre-winter) = late August 2021
● Introduced Poe first to Jake
● After initial chasing was over and 2.0 were settled, add in Obi
● No issues with the third male – bonded quickly with Poe

We allowed Poe a full 24 hours to live in the larger paddock alone, so he knew the lay out before introductions, and Jake and Obi were in a howdy with yard/house so the trio got aquatinted safely.
Our team knew Jake had been fine with introductions to foals before, so it made sense to us to introduce him first. This way, we knew what behaviour to expect.
We saw a lot of chasing the first day, which did not subside as quickly as it did with Obi. We believe this was due to Poe being a more confident zebra, and not "submitting" to Jake as Obi had. We left the two together overnight, and planned for Obi's intro the following day.
The next day was much less eventful, with Obi being very indifferent to the new addition, and chasing/mounting/breeding still happening from Jake towards Poe periodically throughout the next few days.

~ 1 week later ...

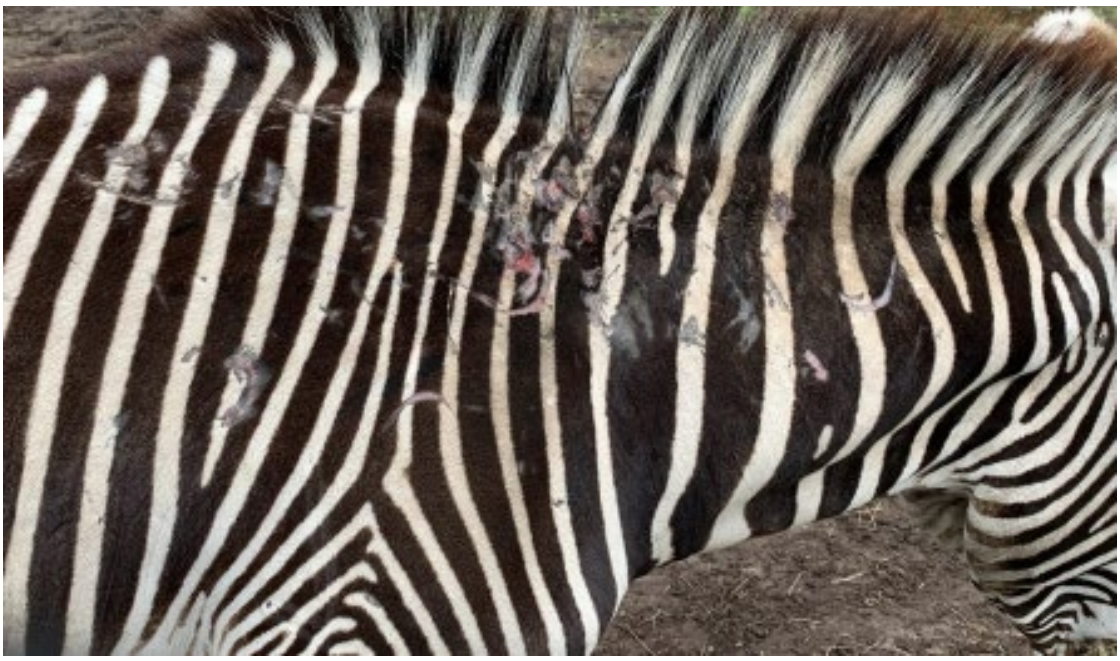
Jake ignoring Poe, but really focused on Obi - chasing, mounting, biting

● Daily photos to document new lacerations and monitor healing

● Regular veterinary checks, but no treatment indicated – felt that wounds would heal if aggression subsided

● Wanted to explore as many options aside from separation with winter approaching

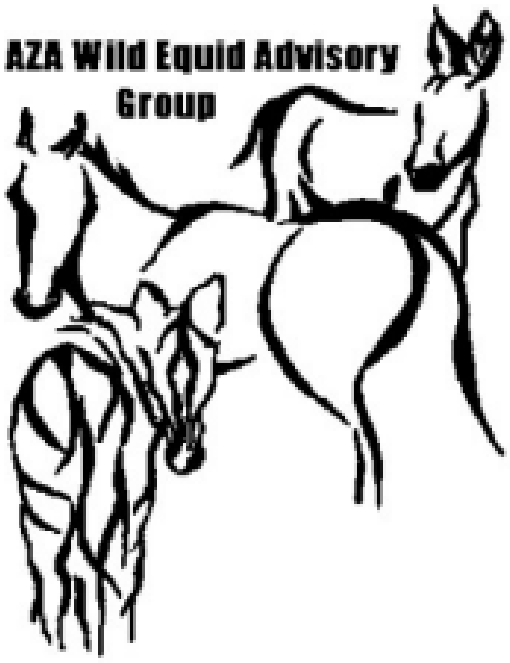
Unfortunately, Jakes attention turned to Obi in a negative way. Poe and Obi were quite bonded, and perhaps Jake was being competitive/possessive of the youngster. No direct cause was ever determined besides Jake just doing what a zebra stallion is supposed to do!
Obi's lacerations increased daily, and our keepers made sure to document each new wound. Thankfully bugs didn't take interest in Obi's cuts, but vets and keepers were becoming more and more concerned about the frequency and comfort level of Obi.



When the going gets tough, turn to the herd!

Special thanks to: • Martha Fischer (St Louis Zoo, SSP Coordinator) • Curby Simerson (San Diego Zoo) • Tony Barthel (Smithsonian National Zoo)

We were very thankful to have so many resources outside of our amazing team! Speaking with other institutions, along with our vets and keeping staff, we were able to come up with multiple solutions to fix our bachelor herd issues!



Possible triggers, possible solutions

*Staff vehicles/feeding anticipation? → Feed first thing in AM

*Resource defense? → Free choice hay, nibble nets, multiple feedings per day, no toys left in paddock

*Lack of access to holding? → risks of cornering; only given when supervised

Ultimately, these changes weren't enough

Medication

- Trazodone, an anti-anxiety medication
- Recommended dose in horses is 7.5-10 mg/kg q4-12h.

*Davis JL, Schirmer J, Medlin E. Pharmacokinetics, pharmacodynamics and clinical use of trazodone and its active metabolite m-chlorophenylpiperazine in the horse. J Vet Pharmacol Ther. 2018 Jun;41(3):393-401. doi: 10.1111/jvp.12477. Epub 2018 Jan 14. PMID: 29333613; PMCID: PMC7167085. • Prescribed dosage: 3.5mg/kg (= 1,500 mg for Jake) BID

- Within the first day of medication, keepers saw a dramatic change in Jake's behaviour
- Goal: use medication to facilitate herd establishment, continue over move to winter space, then wean of

With a dosage of 10 pills, two times per day, Jake's behaviour was a complete 180 from what we have seen over the last few weeks. He was calm and attentive with keepers, and kept to himself when with the boys. Thankfully, this behaviour was not paired with any drowsy symptoms, and showed no negative or adverse effects to the drug.

Winter barn was BETTER for bachelors!

- Jake weaned off of Trazodone (½ dose, 1 week) a couple of weeks after the move
- Stall design = more visual barriers
- Less space = less opportunity to get wound up (and fewer reasons for Jake to discipline the "kids")
- Increase in training/keeper interaction
- Enrichment from other species in barn
- Daily separations for toys and high value food items

On top of seeing another big improvement in the boys dynamic, we also saw that Obi's wounds healed entirely! We were concerned with scarring, but thankfully, his wounds healed and the fur around those areas grew back very well!

Where are they now?

- The plan was to continue the annual move of the boys to the lower paddock for the summer
- Bracing for spring – associated with increase chasing
- At 3 years of age, Obi is approaching sexual maturity
- Fingers crossed for transfer recommendations

A series of unfortunate events…

*Unfortunately, the spring brought on more aggression than usual with potential new triggers…
*Obi being sexually mature
*Frustration with no access to paddock (could see kudu paddock from their holding)
*Increase of hormones from mares in neighbouring barn
*Pent up energy from a bad winter
*The plan: to start Jake on his trazadone, move boys down to their outdoor holding as soon as we could, but this did not help like it had in the past.
*Obi receiving new lacerations daily, & our keeping team had to make a big decision when Obi was injured to the point of becoming lame.

Our bachelor herd is now, unfortunately split into two groups. Our keepers and vet team had to make the tough decision to separate Jake from the two younger stallions, as we were unable to manage his aggression towards them.
Jake is currently living in a paddock neighboring Poe and Obi. They have full visual contact with one another, and Jake has not shown any stereotypic behaviour since the separation.

Plan going forward…

*The boys are currently still in outdoor holding until the weather gets too cold.
*Multiple options for holding space, and basing that on how the boys react.
*Flexible and fluid with our management going forward, to keep boys safe and content.

Thankfully, we have a few different options to house our boys… Birth control for our mares and housing Jake with them, Jake and boys living side by side in barn as they've done well being neighbours this summer, boys living next to mares and Jake living solo in other barn, hopefully sending one or both youngsters to other facilities etc.
These plans are all fluid and we will be learning as we go! We're hoping Jake will continue to do well on his own, as this is the best we've seen him behaviourally, and Obi and Poe have showed that they're very confident without dad around.

Questions?

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Brent Huffman: bhuffman@torontozoo.ca

Dispelling the Myths of Two Key/Two Lock and emphasizing why keeper safety is most important

Erin McNally, LVT
Co-Founder/Director of Crisis Response
GRAZE, LLC
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Introduction:

Most of us at one point in our career have seen a report on a tragedy at another zoo and thought, "That could never happen here". We talk about it, we have training and drills about it, but we don't think it will happen. It can, and it did for the Palm Beach Zoo. The ideas and experiences shared are for planting seeds in how to make a safe zoo safer, they are not to replace any regulatory or accreditation standard. In this presentation I will share what we learned about managing staff, volunteers, and the zoo in the days, weeks, and months after the tragedy and talk about safety strategies that have been implemented to try to ensure that an accident like this never happens again.

On April 15, 2016, tragedy struck at the Palm Beach Zoo and Conservation Society (West Palm Beach, Florida) when a caretaker was fatally injured by a tiger. Many investigations were conducted following this tragic event, and even though all safety standards were met, and no citations were issued, the Zoo decided that the existing requirements and regulations were no longer enough to keep Zoo employees safe. Working as a team, the Zoo staff implemented some key changes to create a more protected environment for the caretakers of the most dangerous animals housed at the Zoo. Implementation of OSHA engineering and administrative control strategies, developed by the Zoo's Director of Facilities, helped to further secure the Zoo.

Investigations and Standards:

There were seven investigations by regulatory and accrediting bodies that were started right away: AZA, USDA, FWCC, OSHA, WPBPD, Workers Comp, and an internal one by the zoo itself. It is important to note that the zoo did not receive any citations from any of the investigations. The OSHA report did come with a list of recommendations of things to consider, based on practices outside of the zoo industry. As stated previously there were no citations, which meant the zoo did nothing wrong, the policies and procedures in place met all accreditation standards, and are the same procedures followed at majority of the AZA accredited facilities, yet the loss of a zookeeper still occurred. The Director of Facilities was tasked by the CEO of the zoo to take the recommendations and to look at them with a different perspective to see what could work in a zoological setting. The goal of the task was to see if there were things recommended that could be implemented to help so that the situation that occurred could never happen again at this zoo.

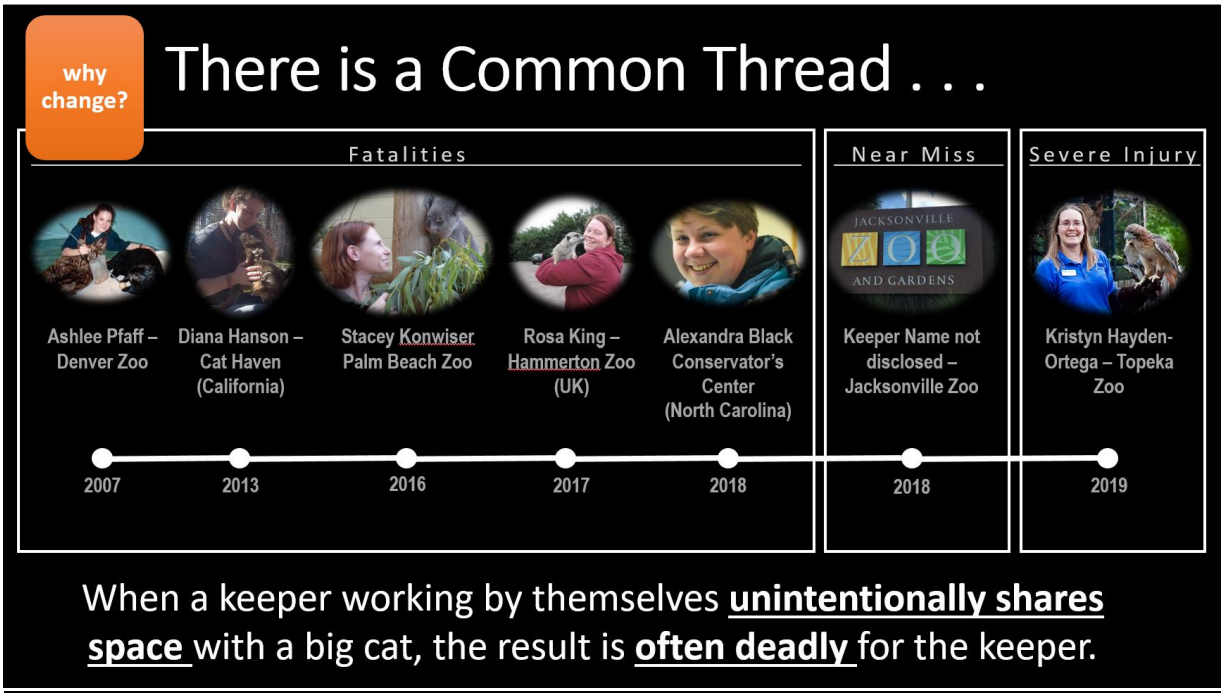
Dispelling the Myths of Two Key/Two Lock and emphasizing why keeper safety is most important - *Erin McNally, LVT*

A Common Tread:

It is often assumed that when these incidents happen, the person involved was green to the field or not well trained in the area. Most often it is quite the opposite. In the incident at Palm Beach Zoo, the care taker, Stacey Konwiser, was a degreed keeper with over 10 years' experience taking care of large carnivores and Tigers were one of her specialties. She wasn't a rookie, she was one of the lead keepers, and she didn't lack in training, in fact she helped to write the protocols of her area. She was an advocate for her animals and their conservation and was a true cultural asset. She was heavily involved in Felid tag and helped out with the Sand Cat SSP. She was all of these things and more. She was also a human being who made a mistake and unintentionally shared space with a tiger.

Upon review of seven incidents involving keepers sharing space with a potentially deadly animals (PDA), a common thread was discovered. (Figure 1 below shows timeline of incidents)

Figure 1:



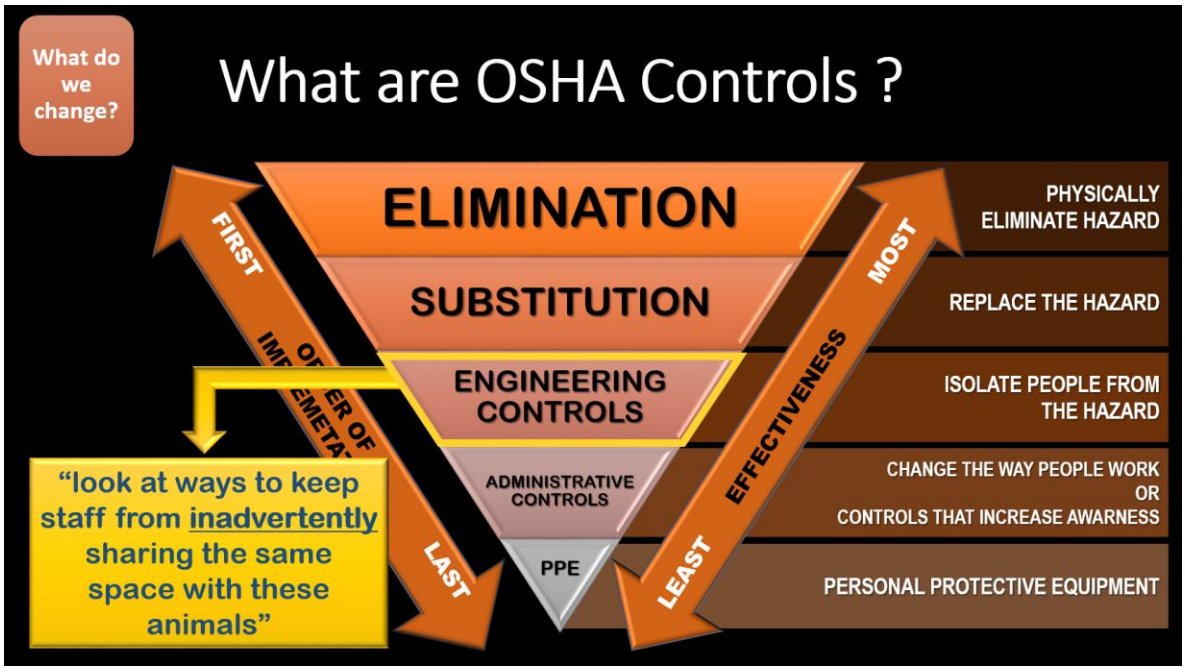
2007 - Ashley Pfaff, an experienced keeper, completed a blind shift of a jaguar, not knowing the animal had shifted back before she closed the shift door, she entered the exhibit, unintentionally sharing space with the Jaguar. 2013 Diana Hanson – an intern, was going out into the lion exhibit as part of her daily tasks, and unintentionally shared space with a lion. 2016 – Stacey Konwiser – a keeper with over 10 years' experience focused on Potentially Deadly Animal's and entered a night house den and unintentionally shared space with a tiger. 2017 – Rosa King – a keeper with over 20 years' experience working with Potentially Deadly Animal's was going

about her morning cleaning of the habitat and unintentionally shared space with a tiger. 2018 – Alex Black – an intern working with an experienced keeper, was helping move enrichment into the lion habitat and unintentionally shared space with a lion. 2018 – Jacksonville Zoo – a keeper was cleaning the habitat when a worker nearby alerted her that here was a lion in the habitat. She was able to face the lion and back into a moat and swim to safety after unintentionally sharing space with a lion. 2019 – Kristyn Hayden – finished cleaning one habitat and entered the second habitat to finish her morning routine, and unintentionally shared space with a tiger. It didn't matter if their level of experience. It didn't matter whether their institution was accredited by a professional association. These are the 7 incidents that we have studied in detail. There are many news stories before, between, and after these. The common thread that was found is: when an animal care worker is working alone and unintentionally shares space with a PDA, the result is often fatal. As the incidents were studied in more detail, a second common thread was discovered: six of the seven individuals involved walked past an opened shift door or walked into a space with a visible open shift door.

Safety Controls:

OSHA separates controls for hazards into 5 categories from most effective to least effective and they recommend starting implementation plans with the most effective first. (See figure 2 for OSHA Hierarchy of Controls)

Figure 2:



Our hazards are our PDAs which are the ambassadors to our mission. The first and most effective OSHA control is elimination of the hazard which is not applicable to our setting. The next is substitution of the hazard, also not applicable. The third control, which is applicable, is engineering controls. Following

that are administrative controls and PPE. The 2 key 2 lock system is an engineering control, but a safety culture is more than that.

The "Swiss cheese model": In the study of safety there is a model called the Swiss cheese model. It was originally developed in the airline industry. (see Figure 3 & 4 for outline of the Swiss Cheese Model)

Figure 3:

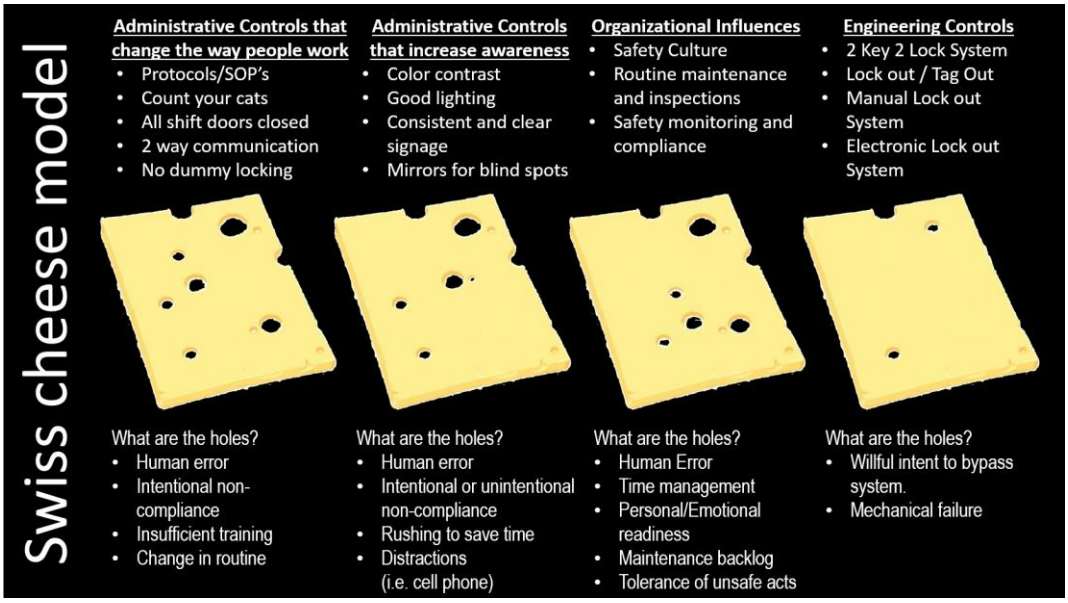
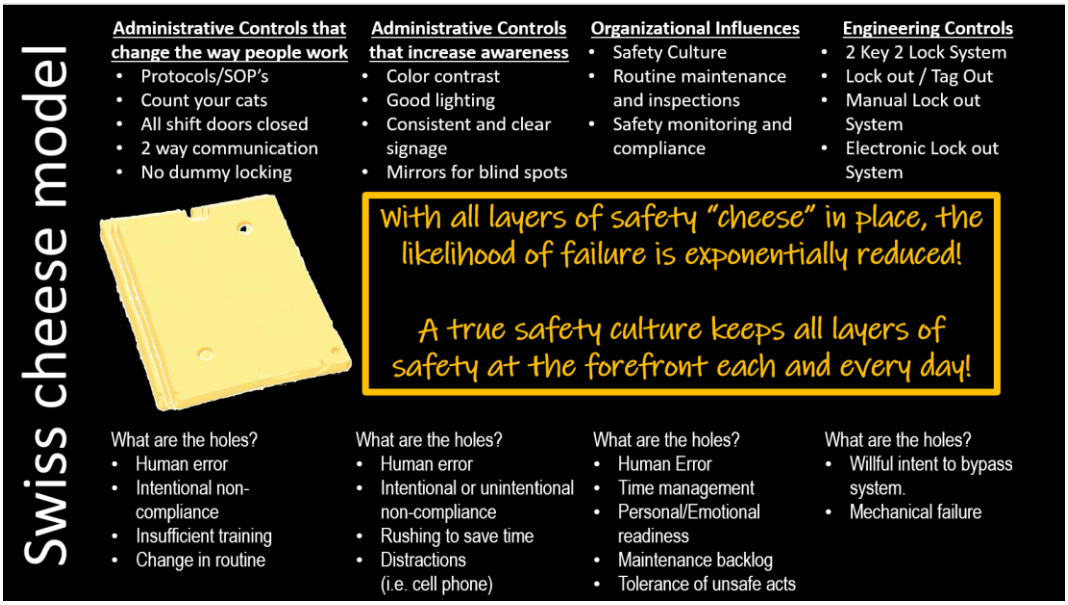


Figure 4:



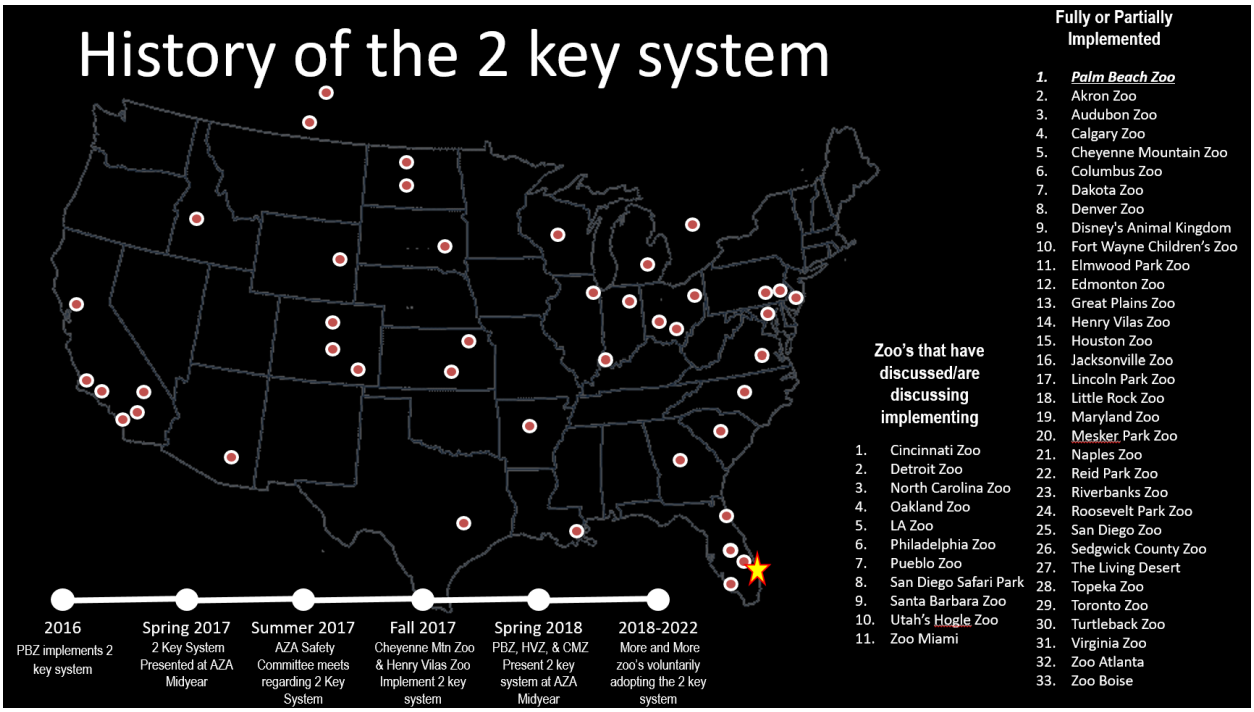
The premise is that there are many layers of safety that go into preventing an incident with any hazard. When it comes to taking care of Potentially Deadly Animals, there are 4 basic layers. The first layer is administrative controls that change the way people work such as protocols and SOP;s, all shift doors

being closed, etc. There are holes in this layer such as human error, insufficient training, changes in routine, etc. The second layer is administrative controls that increase awareness such as color contrast, good lighting, consistent signage, etc. There are holes in this layer also such as human error, intentional or unintentional non-compliance, rushing to save time, etc. The third layer is organizational influences like safety culture, routine maintenance, and safety monitoring. This layer too has holes such as human error, time management, personal emotional readiness, etc. And the final layer is engineering controls such as the 2 key 2 lock system and lock out protocols. This layer also has holes such as willful intent to bypass or mechanical failure. The premise of the Swiss cheese model is that when you stack all the layers on top of each other creating a redundant safety culture in which there are less holes so you exponentially reduce the likelihood of a major incident.

History of the 2 key 2 lock system:

See Figure 5 for a map and timeline of the 2 key 2 lock system

Figure 5:



In the fall of 2016, the Palm Beach Zoo implemented the 2 key 2 lock system. In the spring of 2017, at the AZA Mid Year Safety Summit, the Palm Beach Zoo presented on the 2 key 2 lock system. In the summer of 2017, the Palm Beach Zoo participated in a special safety committee meeting to discuss the safety around PDA along with 8 to 10 other zoos. In the fall of 2017, Cheyenne Mountain Zoo and Henry Vilas Zoo were early adopters and implemented a 2 key 2 lock system. In the spring of 2018 at the AZA Mid Year Safety Summit, Palm Beach Zoo, Henry Vilas Zoo, and Cheyenne Mountain Zoo presented on the 2 key 2 lock system. In the 4 years since then, at least 45 zoos have either fully/partially implemented a 2 key 2 lock system, or have begun the conversation around implementation. There are

140 institutions that participate in the SSP for the key "risk species" that are involved, and approximately 1/3 of them have voluntarily implemented a 2 key 2 lock system.

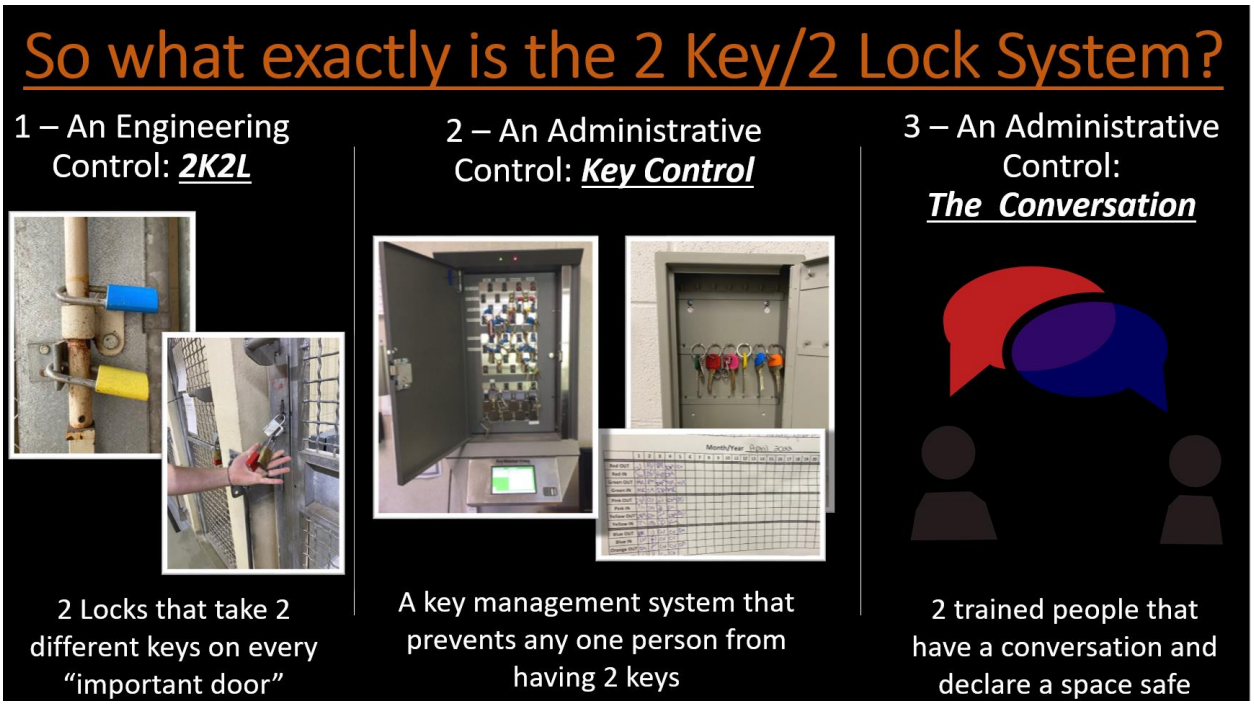
The fundamentals of the 2 key 2 lock system:

The 2 key 2 lock system starts with a change in mindset. The philosophy that has worked and been the baseline for safety in zoos is "the protocol does not allow me to". The 2 key 2 lock system is an engineering control that changes that mindset to "I physically cannot"

The 2 key 2 lock system consists of three basic components (see Figure 5 for a visual diagram):

1. The 2k2l engineering control. 2 locks that take 2 different keys must be on every important door. Important doors are any door that may separate the keeper space from animal space.
2. Key Control: There must have a system in place that is designed to prevent any one person from having both keys at the same time. There are many ways to accomplish this from a simple sign out process to an electronic key cabinet. Zoos have accomplished this control in many different ways.
3. The Conversation: This is a crucial part of the system. The holders of each key must have a conversation describing why the space is safe to enter and expressing verbal agreement that the space is safe before removing the locks. Zoo's do this in all different ways from a formal scripted conversation, to a plain speak conversation about the space.

Figure 6:



An important supporting administrative control: "all shift doors into a space must be closed and locked before entering a space". As was discovered in the research, often an open shift door is the access point for the PDA to enter the space that the care taker is in, so a policy that all shift doors are closed, and

confirmed closed in the conversation, before removing locks and entering space is an important supporting administrative control.

Conclusion:

Two common obstacles to implementation of a 2 key 2 lock system are that it will take too much time and cost too much money. In some cases, safety costs time and in some cases like a 2 key 2 lock system, there is a financial cost to implementation, but it is a fact that injuries and fatalities cost money and injuries and fatalities cost time. Investment in a 2 key 2 lock system along with a culture of safety and appropriate supporting administrative controls has a high likelihood of reducing instances of animal care staff from unintentionally sharing space with PDA.

Resource Document:

There is a resource document available including a recording of the full "making a safe zoo safer" presentation, definitions, supporting administrative controls, etc. This can be found on the ZAHP website (www.ZAHP.org) or the AZA Safety Network.

Implementing Hoof Trimming in Omaha's Giraffe (*Giraffa reticulata*) Herd

Josiah House, Senior Hoofstock Keeper

Omaha's Henry Doorly Zoo and Aquarium

Omaha, Nebraska

Abstract

Nebraska's cold winters, as well as soft indoor substrate, give way to aggressive hoof growth in the giraffe (*Giraffa reticulata*) herd at Omaha's Henry Doorly Zoo and Aquarium (OHDZA). Over time, the hoofstock crew noticed patterns of overgrown and distorted hooves that led to arthritis in the collateral ligaments of the long pastern, short pastern, coffin bone, and fetlock joints. Less mobile giraffe developed flared feet that compounded their decreased mobility. The hoofstock crew initiated a journey of training the herd for voluntary hoof trims. With assistance from the Zoo Hoofstock Trim Program (ZHTP), the Omaha hoofstock crew has been able to routinely trim multiple giraffe in the herd. Using trained hoof presentations, soaking feet, as well as knockdowns, the crew has helped prevent further arthritic changes and hoof wall distortions. The crew has also implemented laser treatment therapy for individuals with chronic arthritis which has proven to help decrease the swelling in joints and increase mobility. The growth of the crew, training program, and daily management has been instrumental in improving the welfare of the resident giraffe at OHDZA.

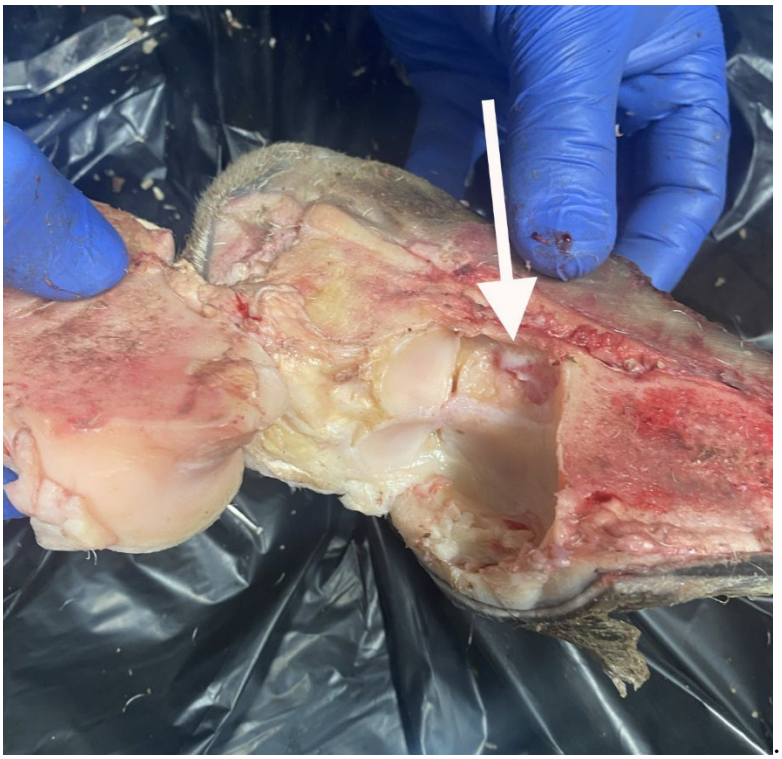
Introduction

Omaha, Nebraska experiences temperatures that dramatically change throughout the year causing the giraffe (*Giraffa reticulata*) herd to spend most of their time on a soft substrate indoors. The months of November through February reach bitter cold temperatures that drop below freezing. The geography of the mid-west allows for cold fronts from the north to settle with little change in temperature. Following the temperature guidelines for our facility, lock out temperatures for giraffe are set at 50 degrees Fahrenheit, and lock in temperatures are recommended at 40 degrees Fahrenheit and below. As of April 2022, Omaha's giraffe barn has been set up to lock the giraffe herd in the display yard, side corral, or in the barn with no yard access options. The barn is comprised of a living floor of mulch to provide cushion and comfort for the herd. Additionally, there are two concrete surfaces in the barn: a treatment stall for medical procedures and the pre-GRD leading into the giraffe restraining device. Image 1 shows

the layout of the giraffe barn at OHDZA.

During cold days when the giraffe herd is locked in the barn, the herd has access to the herd room, training stall, and medical stall providing two different substrate options of mulch or concrete. Due to cold temperature restraints in the winter months, the giraffe herd is confined to the soft substrate of the barn with access to a single concrete stall.

The cold month factors on the giraffe herd leads to extreme hoof distortions that compromise the structure of the anatomy of the lower limb leading to pain and loss of mobility. As the giraffe herd is kept in the barn throughout the winter months, the lack of varied substrates contributes to the hoof growth not being worn off through natural movement. The perpetual growth of the hoof wall becomes long, placing strain on the ligaments holding the structure of the long pastern, short pastern, and coffin bone. The growth also compresses the distal and proximal interphalangeal joints, allowing for painful rubbing and ulceration of the bone. Image 2 points out the ulceration in the distal interphalangeal joint where the short pastern rubbed on the coffin bone.



Eventually the structure of the hoof overgrowth compromises and flares out allowing for improper movement tearing the ligaments turning into painful arthritis. Image 3 points at arthritis that has developed around the proximal interphalangeal joint.

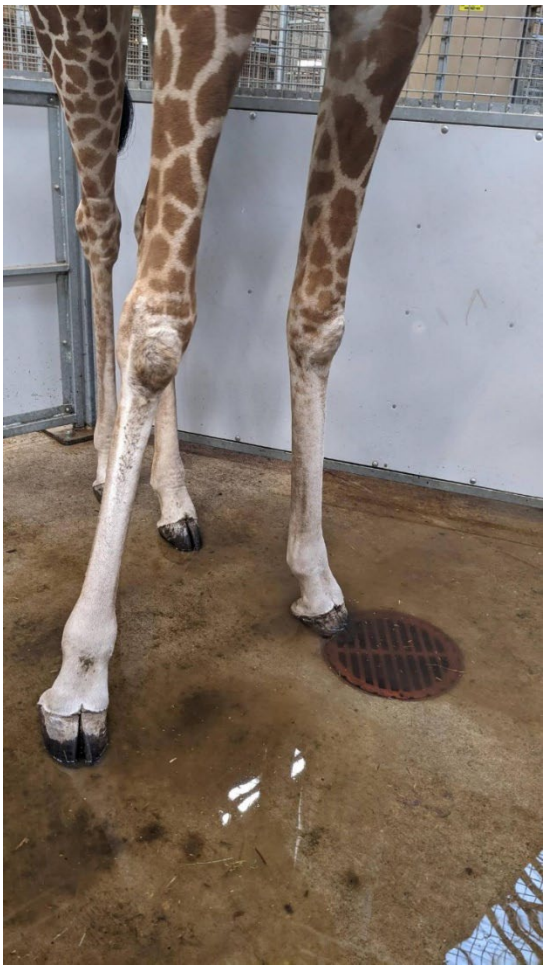
The tendons connecting to the bones in the foot also experienced strain due to the overgrowth. Tendons can tear and develop necrotic ulcers. Image 4 points to an ulcer located in the deep digital flexor tendon in a cross-section of a giraffe hoof.

The distortions become severe, and the pain caused by transferring weight on to the foot reduces the mobility of the giraffe to necessities of food, water, and avoiding another giraffe. The factors of giraffe in the barn for the winter allow for reduced hoof wearing leading to ligaments straining and turning arthritic, bones rubbing producing painful ulcers, and tendons tearing forming necrotic ulcers all of which reduce movement to the necessities.

Methods

Trimming hooves

Through voluntary hoof presentation, the Omaha hoofstock crew was able to overcome hard feet and address hoof distortions. As the understanding of the importance of trimming grew, the hoofstock crew began trimming on the individuals of the herd that were trained for front foot presentation. Photos of the bottom of the feet showed the progression of sole tissue compressing on the foot. Keepers had difficulty removing the sole tissue due to the extent of compression it experienced over the years of buildup, and dry conditions of the barn. Keepers experimented with soaking the giraffe's feet before trimming by having them stand in a puddle of water. This was done by plugging the drain in the pre-GRD space, creating a two-inch-deep puddle. The giraffe were then stationed with a grain or lettuce feeder to allow for the hoof to absorb the water. Image 5 shows the process of soaking the giraffe's hooves before trimming.

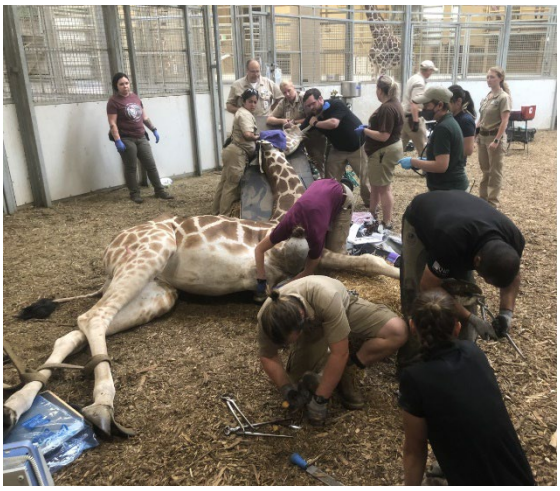


Through this soaking process, the hoof softened allowing keepers to begin removing compacted sole tissue. The softened tissue allowed the keepers to apply less pressure on the hoof when trimming, making the process more relaxed. This process was done once every two weeks, allowing for the sole of the foot to relax on its own and show material that needed to be removed. Image 6 shows compressed sole tissue circled in Sharpe that needs to be removed.

The Omaha hoofstock crew began trimming on the giraffe trained for hoof presentation to address hoof distortions and overcame the difficulty of trimming on hard dry feet.

Kock downs

Individuals in the giraffe herd who were unable to participate in hoof presentation were immobilized in order to correct overgrowth with the help of the Zoo Hoofstock Trim Program. The crew at the time had minor experience in knocking down adult giraffe, as well as different instances that caused further injury to happen due to the induction and recovery process. This caused hesitation in knocking down the individuals with severe hoof distortions. The decision was made to bring in the help of the Zoo Hoofstock Trim Program. Through the assistance of the ZHTP, and the collaboration of veterinary, maintenance, and hoofstock departments, the giraffe individuals with extensive hoof overgrowth were able to survive the knockdown process and begin the journey of correcting the distorted hoof. Image 7 depicts the collaboration needed for a giraffe immobilization.

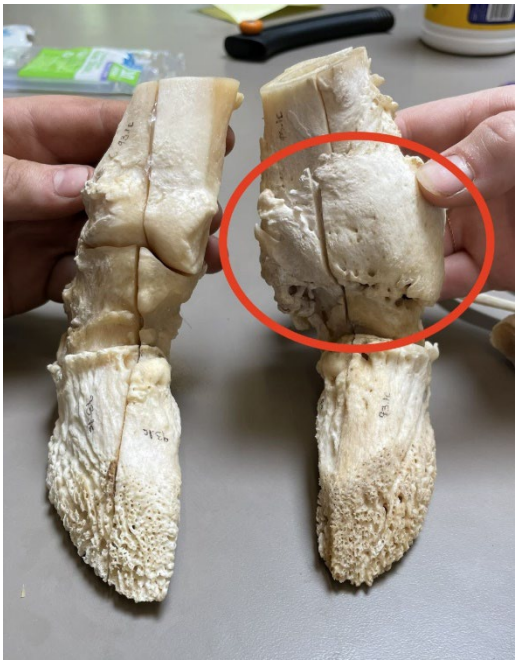


The hoofstock crew with direction from the Zoo Hoofstock Trim Program knocked down the individuals who were unable to participate in voluntary hoof trims to begin correcting the hoof overgrowth.

Results

The giraffe who experienced anatomical changes to the lower limb underwent laser treatment and in a severe case the effected joint fused to provide stability and relieve discomfort. The giraffe with major hoof distortions, once corrected, underwent a laser treatment that lasted 6 months. The sessions would be fifteen minutes long, twice a week, for fifteen weeks, then decreased to once a week for ninety days, and finally decreased to once every other week for ninety days. The session would consist of stationing the giraffe with different reinforcers for the vet tech to flash a laser on the areas of the limb that experienced strain and arthritis. Throughout the laser treatment, we saw increased blood flow to the affected areas, which helped repair the strained ligaments. The treatment also reduced the inflammation in the joint which aided in movement. The giraffe who experienced ulceration on the bone naturally developed arthritic

changes, allowing the proximal interphalangeal joint of the long pastern and the short pastern to fuse. Image 8 shows the fused proximal interphalangeal joint of a giraffe.



The fusing allowed for reduction of bone rubbing on bone and stabilized the joint. This reduced pain in movement and the hoofstock crew saw an exponential increase in movement from the giraffe with the fused joint. Through laser treatment and the fused joint, the hoofstock crew was able to help reduce pain and increase movement in the giraffe with anatomical changes.

Conclusion

The cold winter climate of the mid-west restricts giraffe at the Omaha's Henry Doorly Zoo to the soft substates of the barn. The lack of wearing of natural hoof growth results in hoof distortions that strain tendons and ligaments leading to tears, arthritic change, and ulcerations. Giraffe trained for voluntary hoof presentation had their feet soaked prior to trimming to soften the feet and aid in the trimming process. With the help of the Zoo Hoofstock Trim Program, giraffe unable to present their feet underwent successful knock downs to address extreme hoof distortions. Through laser treatment and a fusing joint, giraffe with arthritic changes had reduced pain and increased mobility.

Ask and You Shall Receive: The Development of a Choice-based Training Program with Large Reptiles

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Introduction

In 2019, Brevard Zoo was in the midst of construction for a reimagined section of the zoo, one that would bring in several new species the zoo had never before housed. Of particular note was the acquisition of venomous snakes. The planning and preparation for this undertaking, along with the zoo's growing focus on improving the welfare of the animals in our care, led senior staff to create a specialized team of keepers to focus on these and other similar species. This would break away from the organizational method of the other keeper teams at the facility, who are divided by geographical sections to correlate with areas of the zoo. Looking at the teams in existence, it was decided that the keepers who cared for the aquatics at the zoo would take on the new challenge of adding most of the reptiles at the zoo into their care. Thus, the Herps & Aquatics team was born.

With a new Herpetological Collection Manager on staff, two additional keepers with several years of reptile experience were added to the previously established aquarist team. Aside from the reptiles and fish, this keeper team had a diverse background as each member had also previously worked with several other taxa from mice to birds to large hoofstock. This unique experience resulted in a group of keepers both passionate about and skilled in operant conditioning, who believed that all animals in human care can and should be trained to participate in their care. We came into our new assignments with open and critical eyes, seeing a world of possibilities and opportunities to improve the welfare of these reptiles, many of whom had lived at the zoo for years but had only received training in the most basic behaviors to enable safe shifting and feeding.

While the team began actively training or planning for behaviors for all of the animals newly in their care, a large focus was made on setting husbandry goals for the largest reptiles at the zoo: Komodo Dragon (*Varanus komodoensis*), American Alligator (*Alligator mississippiensis*), American Crocodile (*Crocodylus acutus*), and Alligator Snapping Turtle (*Macrochelys temminckii*). We wanted to provide better health and health monitoring for these individuals, while promoting choice and control for the animals to provide the best welfare possible. Each of these species and individuals has unique needs and concerns, so a tailored training program was developed for each of them.

A Focus on Animal Wellness

According to the AZA Animal Welfare Committee, "animal welfare refers to an animal's collective physical, mental, and emotional states over a period of time, as measured on a continuum from good to poor." Based on the five opportunities to thrive (Vicino and Miller, 2015) and the five domain model of animal welfare (Mellor and Beausoleil, 2015), the Association of Zoos and Aquariums has established an animal welfare framework that focuses

on nutrition, environment, health, behavior, choice and control, and affective or mental states. In order to promote positive welfare for the animals in our care, we as animal care professionals must strive to provide the most suitable, species-appropriate, positive conditions within this framework as we can. To do so, we must continually assess the wellness of the animals in our care and make positive changes where and when needed. (Animal Welfare Committee, n.d.)

When the Herps & Aquatics team at Brevard Zoo took on the care of most of the reptiles at the zoo, we began the assessment process to look at each element of the welfare framework through the new set of eyes achieved by a complete care team change. Diets were adjusted, habitats were revamped, schedules for veterinary exams were checked and updated as needed. The biggest change, however, was in our assessment of choice and control and their impact on the mental states of these animals.

For the purposes of this paper, the focus of this discussion is the largest reptiles in our care. While the alligators, crocodiles, alligator snapping turtle, and Komodo dragon had a few basic behaviors established in their repertoire, most of these behaviors were centered around feeding them safely. There were virtually no health or advanced husbandry behaviors being trained with them yet, so the majority of the choice and control provided to these animals was rooted in nothing being asked of them and no keeper impact on their natural activities in their habitats. Although this was not necessarily a negative impact on their welfare from the choice and control perspective, it did limit our ability to provide opportunities for optimal health. We sought to improve their welfare in the health domain while simultaneously providing more opportunities for choice and control.

Komodo Dragon

Let's begin with undoubtedly the most enthusiastic participant in our new training program, Sheldon. Sheldon is a 14-year-old male Komodo dragon who has lived at Brevard Zoo since 2018. He is currently the only Komodo dragon at our zoo and has full access to both indoor and outdoor spaces at his choosing. His habitat consists of two outdoor yards connected by a building with a guest viewing window and rooms beyond guest view, as well as a tunnel that connects the two yards. Two doors at the viewing window of the building open to access mesh training panels.

Sheldon was already very well established with his target behavior when we began caring for him. This factor was key in the development of new husbandry behaviors, as the target became a very important tool. We continued to provide target repetitions to further strengthen the behavior, build trust with his new keepers, and building an elongated "hold" at the target prior to reinforcement.

In our review of his records from the previous team, we noticed Sheldon had had some periodic issues with breaking his nails. We began to see some cracks and splits in his nails ourselves, as well. This necessitated providing him with nail trims, initially as treatment for the cracked nails, then as a preventative measure to ensure better nail health. Although we had not formally trained a nail trim behavior when our vet team first wanted to trim the cracked nails, we were fairly confident we could achieve it voluntarily at the training wall. Sheldon had been doing well with training sessions at the mesh training wall, following and holding at the target with his front feet up on the wall and supporting himself on his back feet. Using this behavior, keepers were able to keep Sheldon focused, in position, and regularly reinforced while the vet team trimmed

Sheldon's nails that he placed through the mesh. Amazingly, he paid no attention to the vets whatsoever and was entirely focused on his target and food. Not taking this one incredible session for granted, keepers began regularly training this behavior. Practice sessions included one trainer focused on target, hold, and reinforcement while a second trainer manipulated Sheldon's toes and nails to desensitize him (Photo 1). Throughout this process, Sheldon continues to pay little to no attention to the work on his nails and remains focused on the target. Through this desensitization training and working frequently with our vet staff to perform the trims, Sheldon's nails are now maintained at a healthy length and experience hardly any cracks or splits anymore.

Photo 1: Komodo Dragon "Sheldon" participates in voluntary nail trim training, focusing on a target and reinforcers while allowing keepers to manipulate his toenails. Photo Credit: Jordan Lowery

In addition to his nail health, herp keepers wanted to improve Sheldon's weight and body condition. Sheldon received a slightly overconditioned body condition score (BCS) of 6/9 in 2019. Like most large reptiles, he spent a majority of his time resting and thermoregulating, along with some investigation of habitat and enrichment items. Komodo dragons are naturally ambush predators, who will run at quick bursts of speed to bite a prey animal, then await their toxins to take hold prior to seeking and eating it ("Komodo dragon",n.d.). In order to replicate these shorter bursts of exertion, we designed a komodo exercise program. The habitat is surrounded by windows, allowing a clear line of sight from one end of the habitat to the other, connected by the tunnel. By placing a trainer with a target on either end of the habitat, we trained Sheldon to do "A to Bs": targeting with one trainer, receiving reinforcement, then targeting to the other trainer on the opposite side of the habitat via the tunnel or nighthouse as he so chooses (Photo 2). In order to build this behavior, we used a third trainer with a target pole placed at a midway point just above the tunnel. The third trainer served to direct Sheldon's attention away from the trainer who had just reinforced and instead get him looking and moving in the direction of the target at the opposite end. Initially, the midway trainer reinforced as well, but this was quickly phased out in favor of just getting his attention. Once Sheldon was looking the right direction, the midway trainer hid that target so Sheldon could see and focus on the distant target. This, too, was phased out in just a session or two. Through this process, Sheldon was not only walking more to get to distant targets, but would even run to get to each side. With practice, Sheldon has learned that he needs to go from one side to the other and will participate at length-often completing twelve or more laps. Completing these sessions on average once per week since December 2020, Sheldon has lost 9kg of weight and has improved his BCS to a lean-to-ideal score. He now moves faster, he holds his body up higher off the ground when walking, and he has improved muscle tone.

Photo 2: Komodo Dragon "Sheldon" emerges from the tunnel to reach the target, completing an "A to B" cue.

American Alligators

Brevard Zoo houses 1.1 American Alligators, Toothless and Martha, who have resided with us since 2018. The previous care team had begun some training with the gators, centered around name recognition to call the gators to a location and the introduction of target training. Originally using a small boomer ball on a pole, we made modifications to the targets to swap the sphere for a round flat disc for more precision in the behavior and less of an object for the gators to attempt to bite. With this modification, we were able to progress the behavior more quickly and deliver food more accurately by tossing the reinforcer at the flat disc to slide it toward the gator's mouth. This technique worked well for Martha, who excels at picking food up off the ground, but revealed that Toothless was not so graceful and would need other accommodations. We began training Toothless for an open mouth behavior, so we could more accurately and consistently reinforce him by tossing food directly into his mouth. A combination of touches to the upper jaw with the target to illicit an automatic open response and a target cued just over the nose have been used to shape this behavior. This direct reinforcer delivery is key for successful training of any behavior with this individual.

Using these behaviors, we were able to introduce scale training for the first time with our gators. We began with targeting the gators onto land and around the training area to solidify the target behavior and build endurance throughout the session. A mock scale board was introduced to the session and the gators were targeted towards then onto it (Photo 3). Several sessions were needed to acclimate the gators to the board itself and build their trust walking onto it. Modifications were made to the surface texture as well, as the gators initially had difficulty gaining traction and regressed in the behavior as a result. Once the gators were consistently targeting onto the mock board, we added the bar scale underneath. A small step up was now required to get on the scale, but the many repetitions we had done up to this point meant the extra step proved little challenge. After about seven months of training, we had the first voluntary weights for the alligators.

Photo 3: American Alligator "Martha" practices a hold behavior on the scale board. The scale board is constructed of PVC board sprayed with a texturized spray paint to increase traction. Also pictured is the flat disc target pole. Photo Credit: Sidnee Santana-Mellor.

American Crocodiles

1.1 American Crocodiles, Gollum and Lily, reside in a naturalistic habitat with historically minimal keeper interaction. Like the gators, they were trained for name recognition and come when called to wherever the keeper is located. At one time, Lily was jump trained, but changes in the habitat necessitated that behavior be discontinued. When our team learned that the crocodiles were long overdue for a vet exam, training for medical husbandry and enabling exams became our primary goal. Thus began a long process of planning, preparations, staff training, and animal training to prepare for routine exams for our crocodiles. Fortunately, our management was supportive of our desire to train the crocodiles to participate in as much of this process as possible and allowed us the time needed to do so.

With a goal of providing as much choice and control as possible and reducing the stress to the animals, as well as making the whole endeavor as safe for staff as possible, we decided to shift train and injection train the crocodiles. Our ultimate goal was to voluntarily sedate them before applying traditional restraint techniques in the event of an exam, thereby reducing the stress of the restraint process. A small shift area had been added to the perimeter of the habitat and was typically used to secure the female Lily when the team did landscaping or nest raids, since these

individuals are currently worked through protected contact. We took advantage of her history being called into the shift and began to train the behavior formally with both Lily and Gollum. Using their name recognition behavior, we would call them each to the shift and guide them through the door with a target, reinforcing as they entered and remained calm while in the shift. This process did not take long, as they both quickly learned that all of their food came to them in the shift, and they often would meet us there, ready to participate, before we even called their names.

Having established a shift behavior that allowed us to work safely with one crocodile at a time, we introduced injection training. This behavior began with using a target to line up the crocodiles near the fence line of the shift with the head placed just past an upright support pole of the chain link fence. The head placement was chosen as it provided a stronger barrier should the crocodile respond negatively to the injection by turning the head quickly and forcefully. Approximations were made to desensitize the crocodile to poking, progressing from a 1.5 inch diameter wooden pole to a straightened paperclip to an 18 gauge needle to a 16 gauge needle (the size selected by our vet team). After trialing a few injection sites, we decided that the hind limb was best suited based upon the tolerance level and response of the animals to manipulation of those areas (Photo 4). With each approximation, we began with just a light touch to the upper portion of the rear leg and gradually applied more pressure, reinforcing for calm behavior along the way. A verbal cue of "Poking" is provided prior to the application of pressure, and any movement from the crocodile at that cue is treated as a "stop action" call, halting trainer activity. Should the crocodile choose to exercise this response, trainers remove the training device and give the animal time to settle down (*i.e.*, relax head, exhale a deeply held breath, reposition legs and feet, return to calm body language) before beginning the process again. Through this process, we progressed quickly from a blunt pole to the use of needles. Needle desensitization was very similar to the previous steps, with the gradual application of pressure and elongating the time the pressure was applied until we were able to break through the skin and fully insert the needle into the leg muscle. The continued use of positive reinforcement for each approximation ensured that we were encouraging the crocodiles to continue with calm behavior and choose to participate. While some early needle introductions were met with the anticipated head turn (to which we responded in the same manner as a response to the verbal cue), the most response the crocodiles give now is a readjustment of the leg while the needle remains in place. We collaborated with our vet staff while establishing the behavior with Lily, and they came to several sessions to practice injecting saline solution with a pole syringe, receiving the same calm leg readjustment behavior. Since we had trained Lily to tolerate the necessary pressure for elongated periods of 5-30 seconds, the swift application of saline by the vets required less tolerance and proved that our efforts had been successful. With the behavior well established, we have been able to maintain it with as few as one injection training session per week, allowing us to spread our training focus to other goal behaviors as well.

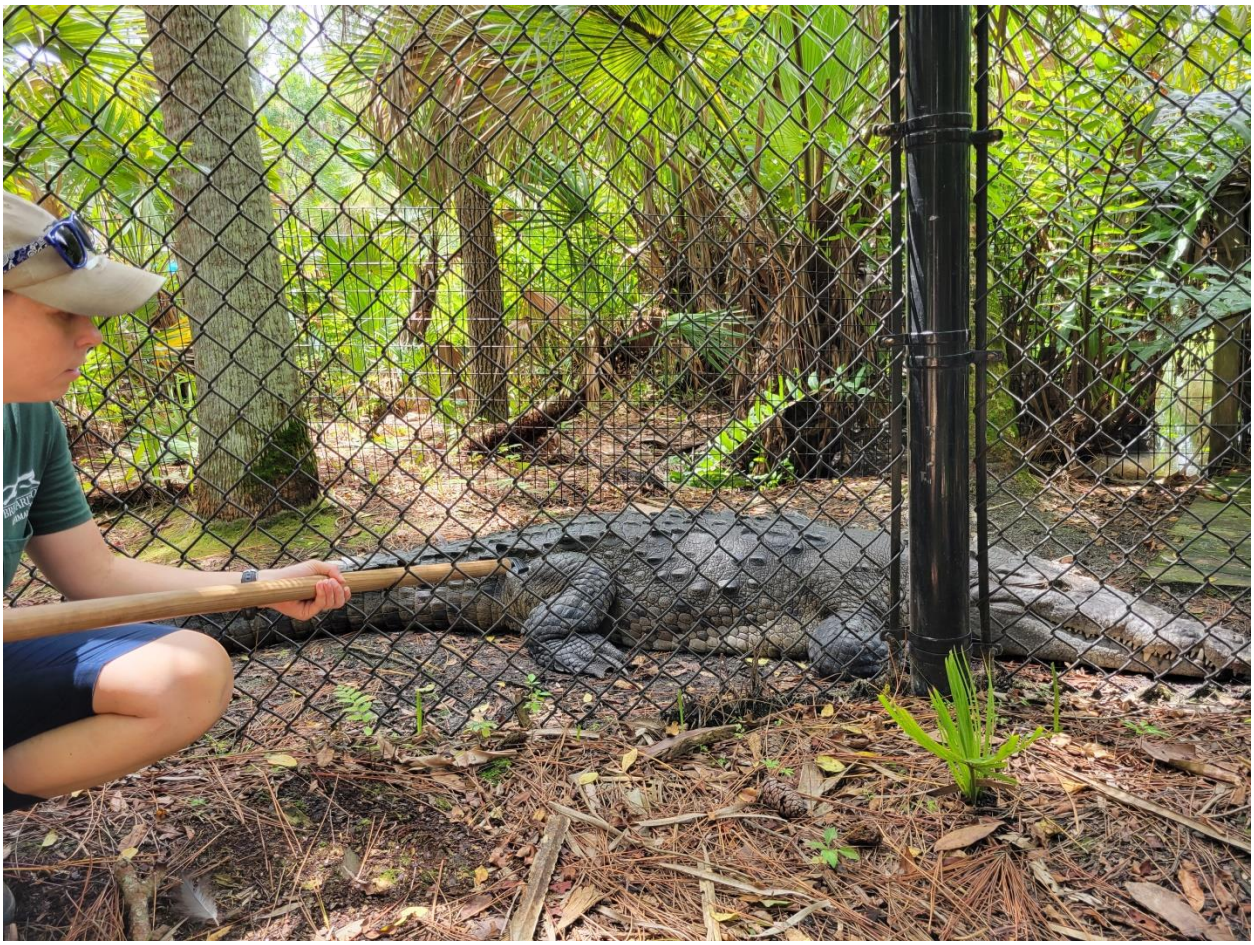

Photo 4: American Crocodile "Lily" participates in injection training, with head placed past the fence support, accepting a needle into the upper hind leg. Photo Credit: Jordan Lowery.

Much like the alligators, scale training for the crocodiles was an important goal. This proved a bit more challenging, as the logistics of a scale and scale board for a crocodile over 15 feet long required some creativity. A bar scale was chosen for best accuracy, and two sheets of plywood were fastened together with 2x4 boards that doubled as railings to center the animal on the board. Once placed in the shift area, the crocodiles were cued to shift. A target was used to encourage forward movement onto the new board, and frequent reinforcement was provided. In the first introduction to the board and scale, both crocodiles successfully walked onto the board, despite some apprehension as we had to hold it down from tipping under their weight. The second repetition went even more smoothly. We had achieved the first voluntary weights ever recorded for these individuals at our zoo (Photo 5). Continued sessions led to a more established behavior and increased the participation of the crocodiles in this important husbandry element. With accurate weights to dose medication, the combination of these behaviors should enable us to reduce the stress involved in a traditional crocodile restraint and more safely conduct veterinary exams for these individuals.

Photo 5: American Crocodile "Lily" participates in voluntary weights for the first time.

Alligator Snapping Turtle

Capone is an alligator snapping turtle who has moved habitats several times in his tenure at the zoo in order to accommodate his growth and improve his welfare. At the time the Herps team began working with him, he was living in a constructed pond behind the scenes that enabled him to be cryptic and challenging to locate by keepers. He was conditioned to come when called to be tong fed, which was helpful that he had a positive history with keeper interactions. Aside from feeding, he was largely hands-off, with the exception of regular weights achieved by manually lifting him onto a scale. Our first goal was to establish a target behavior, using the "boomer ball on a pole" style target we originally had for alligators. Capone very quickly caught on and proved that he was highly receptive to participating in a training program.

Working with Capone's eager choice to participate, we began pushing the limits of what would have been deemed a "natural" behavior. Males of this species are not likely to spend time on land (DiLaura, et al., 1999), however Capone proved that he was willing and capable of following the target up and out of the water, walking along the shore of his pond. He would occasionally meet us at the gate of the habitat, before the session even started. Using the target, we trained Capone to walk onto a scale for voluntary weights. Beyond his following the target on the land, Capone also chose to remain on land for several minutes at a time, accepting multiple reinforcers and holding them in his mouth before returning to the water to swallow. This is the greatest indicator of exercising choice and control—that he chose to forego the biological requirement of being in water to swallow the food in his mouth in favor of continuing to train and earn more reinforcers (Mede, n.d.) (Photo 6).

Photo 6: Alligator Snapping Turtle "Capone" practices walking onto land, with a mouth full of reinforcers ready to accept more. Photo Credit: Danie Ramos.

In addition to these traditional husbandry behaviors, it became necessary to take Capone's nail condition into consideration with his increased walking on land. A routine vet exam provided an anesthetized nail trim with a plan to follow up with more regular trims. The stress of this one exam resulted in a loss of trust from Capone and the need to backtrack in approximations of previously established behaviors. The idea of that much stress on a regular schedule for the sake of nail maintenance was not the level of animal welfare we wanted to provide. Thus, we formulated a plan for training voluntary nail trims. The first element to consider was safety, as trimming nails would place keepers dangerously close to the strong jaws of this animal. A shield of sorts would be required to ensure keeper safety and voluntary participation from the turtle. Training for voluntary restraint with the shield would provide choice and control for Capone in this process. A 5-gallon bucket was adapted for the purpose by removing the bottom and adding a handle to the side. The bucket is just large enough for Capone to place his head in without too much "wiggle room", allows us to regularly reinforce him, and provides a constant visual of his head so trainers can communicate when the "trimmer" needs to back away. This behavior required many more approximations than those trained previously, as well as a mixture of baiting and target use to guide Capone to place his head inside the bucket (Photo 7). After a lot of trial, error, patience, and adjustments, Capone now regularly places his head fully in the bucket and holds it there for successive reinforcers. This voluntary restraint opens up opportunities to safely work closely with Capone as needed to monitor and maintain his health with fewer anesthetized exams.

Photo 7: Alligator Snapping Turtle "Capone" participates in voluntary restraint training, placing his head inside a bucket modified to have a side-mounted handle and two open ends.

Challenges Overcome

All good training plans are accompanied by challenges along the way; it is how you respond to, learn from, and overcome the challenges that makes for a successful training program. These behaviors all came with their fair share of learning curves and challenges that required some adjustments to our original plans. The Komodo dragon, for instance, excels at nail trims for his front feet, however reaching his back nails has proved far more difficult. Attempts were made to access them underneath the perimeter glass, through the use of a training chute and guiding his toes under the window (an approximately 1.5 inch gap). Unfortunately, this technique did not provide the range of motion or access needed to properly trim those nails and was thus discontinued. Plans for a multi-purpose shift box with various panels and ports to enable nail trims, blood draws, and radiographs have been drawn up so we can safely train the Komodo for voluntary participation in a wider range of husbandry behaviors.

Gator training faced individual motivation differences and highlighted the importance of communication and consistency between trainers. While Martha is highly motivated and progresses quickly through behaviors, Toothless is far less interested in using that much energy to haul out and walk a distance to a scale. A few factors may contribute to this difference. Individual differences between the gators certainly play a role, but trainer differences also have a major impact. Martha was primarily trained by one person, while Toothless rotated between two to three trainers. Although we thought we were communicating well, introducing an outside observer revealed that Toothless' trainers had different criteria for the same behavior and Toothless was often doing only as much as the trainer who required the least amount of effort asked. While he was exercising choice and control, he was also not progressing in his training. A suggestion was made to stop asking for easier, short distances and offer him the challenge of a

greater distance, which he met with great success. Requiring more of him resulted in greater participation and enabled the behaviors to progress.

Logistics can create challenges in themselves as well. The Komodo dragon running exercise is challenged by the habitat design. There is a guest viewing area above the tunnel connecting the two yards, which features two sets of windows and a guest walkway. Depending on the time of day, glare from the sun reflects off the windows making it difficult for Sheldon to see past the glass to the target on the opposite side. On crowded days, excited visitors fill the viewing area as well, completely blocking the visual of the target. We are working on a "Go Seek" cue to send him searching for the next target, which will serve as a solution to these challenges. Habitat design has also had an impact on our alligator snapping turtle training. Capone was moved to a new habitat six months after the start of restraint training. Repurposed from another species, this new habitat does not have a shoreline that he can access easily, as the water level does not normally come that high. This has prevented us from progressing with nail trim training as we cannot safely access his nails even if he has placed his head in the bucket shield. It also does not enable him to come onto land to use a scale. We are currently discussing our options and what modifications to the space or to the training we could make to once again provide Capone the opportunity to participate in these elements of husbandry. We have kept up on target and restraint training so those behaviors remain available for future use and continue to provide choice and control.

Discussion

Through our training program, we have been able to engage the large reptiles at Brevard Zoo to participate in their own husbandry and medical care. Providing choice and control in these scenarios has increased the interest these animals have in interacting appropriately with their care team and vastly improved our standard of care. Their wellness has markedly improved in the areas of increased mental stimulation, increased engagement, and healthier body conditions. Our ability to monitor their health has improved, stress levels are reduced as they choose to participate in a variety of husbandry behaviors, and there is a reduced need for sedated exams since they are trained to present for routine aspects of care such as nail trims and weights.

The willingness of each of these reptiles to participate in the variety of training we have introduced, and how quickly they have established these behaviors even if natural histories made it seem unlikely, inspires us to press on in our endeavors. We look forward to conquering the challenges we are currently facing, as well as introducing more behaviors. The establishment of voluntary restraint with the crocodilians and Komodo would be vastly beneficial to reduction of stress when formal veterinary exams are required. Shift and injection training with the alligators is also in the future. With as intelligent and intuitive as these species are, the sky is truly the limit to what can be accomplished through providing positive reinforcement training with choice and control. We have learned the importance of listening to the animals, looking for their cues, and working within the capabilities of the individuals, regardless of species expectations. Even if a goal seems outlandish at first, animals will often rise to the challenge. All you need do is simply ask them, and you just might receive.

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Can You Teach an Old Snake New Tricks?
Transitioning from Traditional Management to Choice and Control Training with Viperid Snakes

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Abstract

In 2019, Shaver's Creek Environmental Center began the process of implementing a training program focused on providing choice and control to our resident Timber Rattlesnakes (Crotalus horridus) and Copperhead (Agkistrodon contortrix). The goal of this program was to increase guest engagement, improve on the welfare our animals were experiencing, and create a safer environment for staff and animals alike.

With the noted decline in the number of AZA institutions keeping venomous snakes due in part to concerns over safety and visitor engagement (Peeling. 2016), training venomous snakes has the potential to influence these factors and create opportunities for improved animal welfare.

We will discuss our experience and perspective training our venomous snakes, the challenges we experienced, and our current goals.

Introduction

As you walk through an Association of Zoos and Aquariums (AZA) accredited zoo, it is not uncommon to see a variety of programming being offered to visitors throughout the day. These programs may range from an informal animal encounter with a single animal to a large, intricate demonstration with a variety of species. While some reptiles have been incorporated into these programs, one group that has been largely absent has been the Viperid snakes.

Venomous snakes face unique conservation challenges, primarily because people are fearful of them. Consequently, they tend to be employed primarily as display animals rather than being presented as individuals in interactive demonstrations. Reptile exhibits can be naturalistic and interesting to view, however, research demonstrates why these static displays may not always be the most effective at influencing conservation-related behaviors in visitors (Torlay, 2020). Implementing positive reinforcement training techniques focused on giving animals choice and control with venomous snakes provides an opportunity for more effective conservation messaging, improved welfare, and continued expansion of training programs.

Shaver's Creek Environmental Center (SCEC) is Penn State University's native wildlife zoo which is home to 15 resident raptors and 22 amphibians and reptiles. The center's animal care staff uses positive reinforcement training with its raptors and was interested in enriching the lives of their other resident animals as well. The staff took on the task of developing a positive reinforcement training program for our resident reptiles, which includes four viperid snakes: three male timber rattlesnakes (*Crotalus horridus*) and a female copperhead (*Agkistrodon contortrix*). Here, we provide a brief overview of lessons learned through this process, the benefits observed with our venomous snakes, and recommendations for getting started at your own facilities.

Before we begin training any type of animal, we consider the following five questions:
1. What is the current husbandry routine?
2. In what areas of this routine could positive reinforcement training be instituted?
3. How do we plan to reinforce desired behaviors?
4. What cues can we use to support training?
5. What shaping plan will best help us achieve our goal?

The following sections will outline the methods by which we have addressed each of the five training considerations listed above.

Husbandry Routine and Training Opportunities

When we began this process, our feeding routine with the venomous snakes was to remove each snake from their respective enclosures using hooks and place them in separate plastic bins with locking lids. The bins were then placed on a scale to record the snake's weight and then moved to the floor where a pre-weighed, pre-killed prey item was offered to them using long metal tongs. If the snake did not take the item from the tongs, the prey item was placed in the bin and left with the snake while their enclosure was serviced. If the snake had not eaten the item when staff were finished working in the enclosure, the snake was placed back into the enclosure and the uneaten prey item was properly disposed of. If the snake had eaten the prey item, the snake was kept in the bin for an additional 5 minutes to help ensure that the snake had fully consumed its meal and then moved back to the enclosure. This process was carried out weekly at a time that was convenient for all staff involved.

When identifying these steps, we began comparing our venomous snake routine with that of our other resident animals, including our raptors, to identify where training could potentially benefit our venomous snakes. We noted our other animals voluntarily transferred to and from their enclosure, while our snakes were moved by staff. As such, our vision for our venomous snake program was to train our venomous snakes to voluntarily exit their enclosures, move into their weighing bins, and then go back into their enclosures, all without any physical handling. We believed that this would not only be great exercise and enrichment for our snakes, but it would also help our students and visitors to empathize with these animals by seeing them as individuals capable of making decisions. We also believed that this training would help make working with these animals safer for staff. By training the vipers, we would give the snakes control over when and whether to transfer to their weighing bin and the opportunity for more exercise, while also retaining the husbandry routine both we and the snakes were accustomed to and not exposing keeper staff to additional risk.

Identifying an Effective Reinforcer

Prior to initiating our venomous snake training program, we had been experimenting with target training for our resident colubrid snakes. When establishing this system, we looked at the average weight of the prey items being offered to the individuals each week and how that affected the snake's average weekly weight. To increase the number of training sessions we could have, we decided to start feeding our colubrids twice a week, offering them the same total amount they would normally receive but on two separate days. To avoid having to feed them small or juvenile prey items exclusively during a session, we also transitioned to offering them their diets cut into progressively smaller pieces until all the colubrids were engaging in two sessions weekly, with each session consisting of between 8-12 repetitions.

Although this feeding method had worked for our colubrids, there was no guarantee our vipers would respond in a similar way. This was especially true for our timber rattlesnakes. While the copperhead would immediately begin eating food that was offered to her, our rattlesnakes preferred to strike their food and allow a few minutes to pass before consuming the prey item. This routine was presumably a function of their natural history, as rattlesnakes in the wild will often strike their prey to envenomate them, and then wait as their venom takes effect. Then, once enough time had passed, they would track down the now deceased animal and consume it. The snakes in our care would regularly take between 10-30 minutes to complete this process depending on the size of the prey item offered. This delayed method of feeding was one of the biggest questions we had through this process. Does too much time pass between the behavior being completed and the actual consumption of the reinforcer for us to actually train our snakes? And, if we are able to train them, will they accept prey items that have been cut into multiple pieces?

To help answer this latter question, we first offered them smaller rodents and quail than they would typically be given. We were able to establish that our vipers recognized a smaller prey item as food, so we began offering them rodents, day-old chicken, and quail cut in halves. Then we shifted to offering rodents, day old chicken, and quail cut into multiple, smaller pieces. Our copperhead would readily accept adult mice cut into four pieces. However, our timber rattlesnakes were most successful eating food items either cut in half or in 3 pieces. We decided to use these partial prey items as reinforcers.

Identifying and Establishing Cues

The vipers in our care range in age from approximately 3 years to over 10 years and have lived at SCEC for the majority of that time. We assumed that during this time they had likely learned the routines associated with the various aspects of their care. To identify possible feeding cues, we began paying closer attention to our snakes' body language while we prepared to feed them and noted at what point in the process we began to see anticipatory behaviors such as a raised head, increased tongue flicks, or movement towards the enclosure doors. Each routine varied depending on the logistics of that specific enclosure, but we were able to identify cues that resulted in anticipatory behaviors in each snake, including the presence of the tongs or hooks, sliding rear-opening enclosures to the center of the room, opening specific doors, etc.

With the overall goal being to showcase these newly learned behaviors to the public in the safest and most positive way possible for both the visitors and the staff, we wanted our training to be conducted in a visible area and our guests to leave a training session with a newfound appreciation for reptile intelligence, rather than startled by a sudden strike when the snake acquires the prey item. With this goal in mind, we went over ways to make the delivery of the reinforcers to the snake as calm and relaxed as possible. We initially decided to use an orange cup to cue the snake that food was available and hide the previously mentioned strike from our guests. To begin, we first introduced the cup and food to the copperhead. The food was placed in the cup and then lowered inside the enclosure with a pair of tongs. Once the copperhead was reliably approaching the cup, we replaced the tongs with a dowel rod attached to the side of the cup (see Photo 1: Tools).

While this method of food delivery was successful with the copperhead, we were unsuccessful at utilizing it with our timber rattlesnakes. The rattlesnakes regularly ignored the still food and even when they did engage the prey item, they often had difficulty maneuvering the food out of the cup to consume it. These challenges along with some issues the staff experienced maneuvering the cup within the enclosures led to us ultimately phasing out this delivery method for both species in favor of offering food using cup-free tongs. This method harnesses a cue that our snakes already associate with food and, therefore, provides a practical and efficient way to reinforce the snakes. Although it is highly visible to and does not reduce the intensity of the strike, we have not observed negative reactions from guests.

Shaping Plan and Target Training

Next, we had to develop our shaping plan. We had needed to decide what behaviors were necessary to train the snakes in order to achieve our goal of voluntary weight checks and enclosure shifting. After some discussion, we decided that target training these animals would be the best fit, as it would allow us to ask our animals to approach specific areas of their enclosure as well as other desirable exterior spaces.

We chose to use a lollipop target (a long dowel with an orange ball on the end; see Photo 1: Tools). The target was similar in shape to the pair of tongs typically used to deliver a food item and was made of orange plastic like the cup that was associated with food. We thought these similarities might encourage the snakes' interest in the target, but (we hoped) the target would be different enough that the snakes would learn not to strike the target.

To limit the chance of accidently training the snakes to strike at the target, we avoided baiting the target itself. There was some concern that the scent of the prey would encourage a strike and, because the snake would then immediately be reinforced for this strike behavior when it attained the food, we could ultimately end up training for this behavior we were trying to avoid. With this in mind, we disinfected the target prior to each session and kept the food accessible to the trainer, but as far from the target as possible.

Our initial criteria established for the snakes was that they receive their reinforcers (food) after demonstrating "a purposeful look," which we defined as any physical acknowledgement of the ball (Photo 2: Purposeful Look). This could be expressed as the shifting of the pupil, a directional tongue flick, or the turning of the head towards the target. If the snake displayed any of these behaviors, a food reinforcer was delivered by the trainers.

Once the snakes were consistently turning towards the target, we increased the criteria for them. Now we wanted them to display that "purposeful look" while also moving toward the target (Photo 3: Approach Target). At the onset, our copperhead would not approach the target. We chose to slightly sway the target in place to see if the movement would provoke her curiosity and cause her to approach. Because we were now moving the target, we had to watch her body language carefully while practicing this technique to make sure that if she showed signs of preparing to strike at the target, we could try to deliver the reinforcer prior to her committing to the strike itself. Over the course of a month, we were able to slowly fade out the rocking of the target until all the vipers were approaching the target reliably without any extra movement of the target.

Although we tried to take precautions and deliver reinforcers to our snakes prior to striking, some of our snakes did occasionally strike the target. When this occurred, we would pause for a few seconds and wait for the snake to offer us one of the "purposeful look" behaviors following the strike and deliver a reinforcer for that behavior instead. Utilizing this method, the striking behavior quickly faded.

Given that the snakes were reinforced for the behavior of being within a generalized distance of the target rather than physically touching the target, we began experimenting with sliding the ball away from the snake a few inches at a time to allow the snakes to follow it. However, we found that for our individual snakes, this led to a breakdown in their targeting behavior. Once we reestablished the stationary targeting behavior again, utilizing our original criteria, we began placing the target at increasingly greater distances rather than dragging the target, which led to greater success.

While we have been able to train our snakes to target in and out of their enclosures voluntarily (Photo 4: Using Ramp), we are still working on the logistics of having them on a scale.

Benefits of Positive Reinforcement Training

We have observed several benefits of positive reinforcement training with our viperid snakes. Since we instituted a positive reinforcement training program, our vipers are losing excess weight, thus becoming more physically fit, and they are becoming more active. They are more interested in novel objects, spend more time out in the open areas of their enclosures, all while displaying more comfort behaviors in our presence overall. In addition, their voluntary participation in husbandry has made it easier for us to manage them and reduced their reactivity to our work.

The biggest change we have noticed has been with one of our male timber rattlesnakes, Leo. Previously, Leo would display several stress related behaviors whenever his enclosure was accessed for any reason: rattling was a regular occurrence and he occasionally struck at staff members during husbandry. Since establishing our training program, Leo has stopped rattling when his enclosure is accessed and has not struck at any staff members. We interpret this as a positive change in this animal's behavior and welfare which coincided with us implementing a scheduled training routine. We are currently engaged in quantifying the training process to provide scientific support for the benefits we've observed in our snakes.

In addition to changing our snakes' behavior and improving their welfare, we also hope to change visitors' negative perceptions of snakes. Watching direct interactions between animals and their caretakers can help visitors become more empathetic toward animals. While we have not yet been able to display these behaviors in our public programming, we have seen a shift in attitude among our students and fellow staff members. Prior to observing training sessions with venomous snakes, many of our students and staff understood our vipers were valuable as ambassadors for their species but viewed them as dangerous to be around. We now regularly hear students talk about the vipers with the same tone and reverence that they do when speaking about the other resident animals.

How can I become a viper trainer?

In our experience, snake training is fundamentally the same as training any other animal. If you currently work around snakes at your facility and have any sort of routine for how you feed or interact with them, you have probably already trained your snakes to associate particular cues with husbandry activities. If you watch your snakes' behavior closely while you or another keeper prepares their food or services their enclosures, you may notice your snakes displaying some anticipatory behaviors. If you see these, you are already a snake trainer - congratulations! If you don't see these behaviors, consider implementing some cues to help your snake understand your intentions during each interaction. Even if you don't have the time to build a full training routine, being aware of what you are telling your snake through the environmental cues you provide can go a long way in building a relationship with your animal.

We have observed three main differences while training snakes, as compared to birds and other reptiles: a) training sessions take longer, b) snake behavior is very subtle, and, c) snakes perceive scent and temperature more strongly than vision. Depending on the species and the individual, our snakes tend to move very slowly when training and often become distracted by the various scents around them. These factors combined with the time it takes for a snake to consume the reinforcer, especially with some vipers' delayed feeding response, means a training session with one of our vipers typically lasts 30-60 minutes. This does not mean that training a viper or other snake is not a worthwhile endeavor; it simply means that you should be prepared for the time commitment when starting this process or implementing any of these components into your program. It is also critical to recognize and reinforce behaviors that are signs of interest in your snake, especially in the early stages of training. If you have not spent substantial time watching snake behavior, consider partnering with someone who has experience so that you can learn to recognize these signs (which may be as subtle as changes in eye or head orientation). Finally, pit vipers (including our timber rattlesnake and copperhead) are highly sensitive to the temperatures of the objects they are interacting with. If a target is typically stored and utilized at room temperature but was then moved outside in the heat or the cold prior to a session, a snake may not recognize the target. Similarly, the temperature of the food reinforcer can influence whether they accept it.

Every animal is an individual, so keepers should be prepared to adapt their training program in response to their individual snake's behavior. At SCEC, having caretakers with experience training other animal species and guiding the development of our training program has been invaluable; consider partnering with experienced trainers in other areas of the zoo as you develop and implement your training plans. And remember to take time to enjoy the process. Training the venomous snakes has been one of the most challenging yet rewarding experiences our staff has had the opportunity to engage in. As trainers, each interaction with our vipers has been an opportunity for us to learn about various training methods, but more importantly, about the individual animals under our care, thus allowing us to continue to raise the bar on providing them the best possible welfare.

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An Easy Pill to Swallow: Training 1.2 American black bears to voluntarily take pill capsules

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Introduction
Administration of oral medication is an important but often challenging aspect of maintaining a healthy animal collection. For many species, including American black bears (*Ursus americanus),* it is common for staff to conceal medication in an animal's favorite food items. However, once an animal realizes something is hidden inside, they will often spit out the medication and may even begin to refuse the food item altogether. Staff may then have to repeatedly switch to new and different food items in search of a way to hide the medication once again.

This was the experience of the Animal Care Staff at the Frank Buck Zoo when it became necessary to administer long-term daily medication to 0.1.0 senior American black bear, hereafter referred to as "Brighton." Trying to conceal pills in her food quickly became a coercive, time-consuming, and often unsuccessful process, leaving everyone frustrated. Animal Care Staff decided to refocus their efforts on finding a way to make medication administration an easy and positive experience for everyone.

Initial Training Process
Animal Care Staff took inspiration from voluntary pill-swallowing behaviors that have been trained in elephants and some primate species. Training plans for these species commonly include steps such as training an open mouth behavior, desensitizing an animal to having different items placed in their mouth, and capturing a swallowing behavior. Staff could not find any examples of this behavior having been trained in a bear, so quite a bit of trial and error resulted. To her credit, "Brighton" is very patient and eager to please, so despite a clunky training process, she did ultimately learn to voluntarily take her daily medication in unflavored pill capsules. Throughout the process, staff learned a lot about what was and was not effective, which proved to be an asset when the training was replicated with other bears.

Lessons Learned
In the early stages of training, staff was concerned that if "Brighton" bit open a medicated capsule with a bitter flavor, it would cause significant regression in the behavior. They turned to unflavored empty pill capsules, which are readily available for purchase, as a training aid (Image 1). Empty pill capsules are also available in flavored varieties and come in many sizes ranging from 5 (smallest) to 000 (largest). Purchasing multiple capsule sizes allowed for incremental increases as "Brighton" became familiar with the behavior (Image 2).

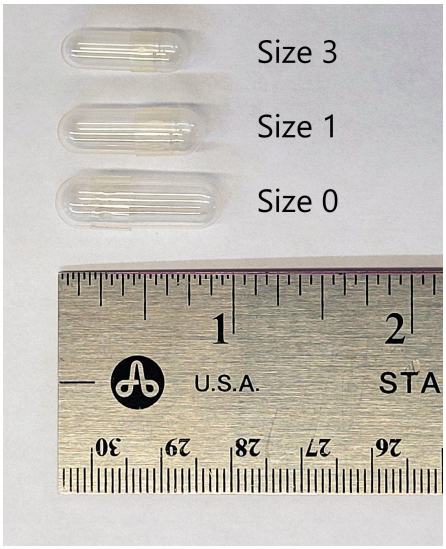

Image 1(left): Size 3, 1, and 0 empty pill capsules were used during "Brighton's" initial training. Image 2(right): The pill capsule size incrementally increased from approximately ½" to ¾" long.

The initial plan had been to reinforce "Brighton" with fruit when she consumed a capsule. Ultimately, Animal Care Staff determined that delivering a stream of liquid along with a pill capsule was the ideal way to encourage swallowing in the early stages of training. Years prior, "Brighton" was regularly trained using Gatorade® delivered from a 60cc syringe as reinforcement. Staff turned to Gatorade® again, which improved the mechanics of swallowing an otherwise dry pill. Simultaneously, the produce reinforcement was discontinued; using Gatorade® as the only reinforcement had additional benefits including enabling staff to precisely control the quantity (duration) given. Staff also determined that it was helpful to deliver the capsules and Gatorade® from a position slightly higher than "Brighton's" eye level. This encouraged her to tilt her head upward, making it easier for everything to move toward the back of her mouth.

Finally, staff learned that when the pill capsules would make contact with the saliva on "Brighton's" tongue or lips, it often would stick to them, causing a breakdown in the process. Staff found that by first dipping the capsule in a substance such as honey, vegetable oil, or even the Gatorade® itself, the pre-moistened pill would not stick to the bear's mouth as easily. These substances also made the pill more slippery and likely facilitated easier swallowing.

Revised Training Method

The next year, Animal Care Staff set the goal of training the zoo's two young American black bears, 1.1.0, to also swallow pill capsules voluntarily. Using the lessons of the previous year, an entirely new approach to training the behavior was formed. The new plan involved a simple pairing procedure to teach the bears that consuming low (or neutral) value items would be followed by high-value items.

These two bears first had to learn how to effectively drink a stream of Gatorade® out of a syringe. This was a new experience for them, and their first reaction was to lap at the stream of Gatorade® as it fell. It took about a week for them to figure out how to put their lips around the tip of the syringe and swallow the liquid directly as it was dispensed into their mouths.

Once the bears understood how to drink out of the syringe, staff prepared training "pills" made out of carrots (Image 3). The purpose of these stand-in pills was to teach the bears that by consuming an item of low value, they would then receive something of high value. Carrots were chosen as they are a low-value food the bears regularly receive and are easy to cut up into specific shapes and sizes. The carrots were cut into thin, ½-inch long strips, approximately the dimensions of a size 3 pill capsule. At this small size, the bears could easily swallow the carrot pieces whole, as they would when taking an actual capsule. Nonetheless, the bears initially did painstakingly chew each tiny piece of carrot, and then were given a stream of Gatorade® to drink. During five sessions per week, roughly ten carrot pills were paired with Gatorade® in immediate succession. The bears learned that if they did not eat the carrots immediately they would not receive Gatorade®.

Image 3: Small carrot pieces were used to practice swallowing something the size of a pill capsule without chewing it.

After a few sessions, the bears figured out that the carrot pieces were disinteresting, and the quicker they consumed them the faster they would receive Gatorade®. Accessing the Gatorade® became their primary objective, and the bears began to immediately swallow each carrot piece whole. The process became so quick that staff was administering the Gatorade® immediately after each carrot, and multiple "pills" could be given in very rapid succession.

Once the bears reached this point, staff introduced size 3, empty, unflavored gelatin pill capsules. During the first session with the pill capsules, staff began by giving carrot "pills" and Gatorade® to the bears as normal. After a few carrots were swallowed a pill capsule was given in the place of the carrot. The stream of Gatorade® was offered at the same moment that the pill capsule was given to encourage swallowing, and both bears swallowed the capsule without hesitation. The first bear went on to swallow three more capsules without hesitation during that session. When the second bear was offered another capsule, he mouthed it for a moment before spitting it out to sniff at it. After investigating, he ate it off the ground and was heavily rewarded with Gatorade®. From that point on, neither bear spat out any capsules during their subsequent training sessions. Due to the quick success of switching from carrot pieces to empty pill capsules, the carrots were discontinued the next day. Over the next few sessions, staff started to delay the Gatorade® delivery until after the capsule was swallowed, as had been the criteria with the carrot pieces (Image 4).

Image 4: One of the bears is given a pill capsule. A syringe of Gatorade® is ready to provide reinforcement as soon as the pill is swallowed.

Just two weeks after starting to train the young bears to swallow capsules, one of them suffered a minor injury that required a course of NSAIDs. This particular bear had historically been extremely challenging to give medication to. She had proven very eager to take the empty capsules during training, so staff decided to see if the behavior was ready for use with real medication. She was offered a tablet, smaller than the capsules she had been swallowing during training, which she consumed without hesitation. Due to this immediate generalization of the behavior to include different forms of medication, she was able to complete her treatment on a completely voluntary basis.

Final Outcome

Over time, Animal Care Staff have worked with the bears to increase the size, quantity, and variety of medications they will accept. They will all swallow at least size 0 capsules (roughly ¾ inches long), will consume upwards of 20 capsules consecutively, and will even swallow 2-3 capsules given at once. All three have also demonstrated willingness to take large bitter tablets or chewable medications using the same process. This behavior allows for virtually any medication to be administered quickly, accurately, and with enthusiastic participation from the bears. Staff no longer attempt to hide any medications from them, instead, they voluntarily participate in their medical care.

Conclusion

The method used to train the second two bears to voluntarily swallow pill capsules was a break from training plans for other animals in which open mouth behaviors are shaped, swallowing is captured, animals are slowly desensitized to tasting bitter liquids, and so on. In comparison, the pairing procedure in which the bears learned that consuming low-value items would result in high-value items, is elegant in its simplicity. Considering that within two weeks of beginning training, one very finicky bear was voluntarily taking medication indicates that this method is both effective and efficient.

Voluntary pill swallowing behaviors have not been attempted in most zoologically managed species. The ease with which the bears mastered the behavior suggests that, with species-specific adjustments, this novel training approach could put pill swallowing well within reach of countless other species in which it has not been documented so far.

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"Habituation, enrichment and training of an adult male of Hamadryas baboon *(Papio hamadryas)*"

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Introduction

The Hamadryas baboon (*Papio hamadryas*) is a terrestrial, medium sized monkey. The skin on their face is hairless and grayish-brown and they possess a long, dog-like snout. This species is highly sexually dimorphic in size and pelage characteristics. Males are much larger and weigh twice as much as females, with males weighing approximately 18-20 kg (40-45 lbs) and females weighing 9-11 kg (20-25 lbs) in the wild but higher under managed conditions. . Males are silver colored and have a pronounced mantle that they develop around the age of ten, while the females are capeless and brown. Both sexes have ischial callosities that are highly developed and bright red (Brent, 2005; Turner, 2009 & Wiley, 2020).

This primate is found in sub-desert, steppe, plains and savannahs of northeastern Africa. Their range extends through Egypt, Ethiopia, Somalia, Saudi Arabia and Yemen. The distribution is limited by availability of watering holes and appropriate sleeping cliffs (Brent, 2005; Turner, 2009 & Wiley, 2020).

Hamadryas baboons are omnivores and eat a wide variety of foods including: grass, rhizomes, roots, tuber, eggs, nuts, small birds, invertebrates, and mammals. They also consume fruits, leaves, and flowers. Food resources are limited and generally widely dispersed (Wiley *et al*., 2020).

As in all baboon species, hamadryas are gregarious and live in troops of over several hundred individuals that are subdivided into smaller groups named bands, each one composed by a One Male Unit (OMU) or harem which is the core of the hamadryas baboon society. Each OMU contains a one dominant male that maintains control over several females, his offspring and on occasion, submissive followers. In addition, this species has a wide behavioral repertoire that allows a defined social structure within and between bands that helps the entire troop to have a very complex and unique fusion-fission organization. This structure has enabled the species to exploit limited resources of desert life and promotes protection against rivals and predators.

The Hamadryas baboon is currently enlisted on the IUCN as Least Concern and Appendix II on CITES. They are threatened due to habitat loss and harvesting for food and research.

The main objective of a modern zoo is to satisfy, as much as possible, all the requirements needed by each species under human care, constantly searching to improve animal welfare. The requirements that must be accomplished for the species to thrive are by offering veterinary care for good physical and mental health, a well-balanced diet, a wide diversity of positive stimuli, and a comfortable and challenging environment; all while taking into consideration the characteristics of each species, their natural history, individual history, age, health records and the conditions and criteria of how the zoo is managed. In addition, zoos should have

a high level of commitment to society because they are responsible for raising awareness about global biodiversity conservation, the ecosystems and ecological processes that take place around us, and how all of that has been affected by human action.

Two of the most representative aspects of animal welfare under human care are the environmental enrichment and the operant conditioning. The first is the process of researching, designing, applying and evaluating diverse activities that promote the physical, psychological and social welfare of the animals. This is accomplished by offering them stimuli and positives challenges that help them to express natural behaviors and stimulate cognition according to the characteristics of each individual within the same species.

Operant conditioning uses the consequences of a behavior to modify the occurrence and the form of a behavior. Reinforcement and punishment are the core tools of operant conditioning. Positive reinforcement occurs when a behavior is followed by a favorable stimulus to increase the frequency of the behavior. Negative reinforcement occurs when a behavior is followed by the removal of an aversive stimulus to also increase the frequency of that behavior. Positive punishment occurs when a behavior is followed by an aversive stimulus to decrease the frequency of that behavior. Negative punishment occurs when the behavior is followed by the removal of a favorable stimulus to decrease the frequency of that behavior (Wiley, 2020)

In fact, operant conditioning encourages the animal to tolerate being in close proximity to zookeepers and provides general observational opportunities. In addition, it serves as an occupational therapy in that it offers the animal the control of their environment and a more enriching daily routine.

Enrichment and animal training are very commonly used with the hamadryas baboons. It is essential for a day to day management, useful for reducing stress, and aids in facilitating medical routines and daily cares. It also enhances the diversity of activities according to their natural behavior, such as foraging, climbing, social bonds, etc. (Wiley, 2020)

Main Objective

The main objective serves to share the challenges that accompany working with animals that are gregarious in natural conditions but have been kept in solitary conditions. The discussion will include the methods, tools and procedures that have been applied to promote daily welfare, through enrichment, operant conditioning techniques, and the creation of a challenging environment.

Materials, Methods and Results

Subject

The individual treated in this project was a very young specimen that arrived at the zoo almost 12 years ago. He is currently a mature youngster male, named “Güero” (Blond in Spanish) (Fig. 1). He lived in solitary conditions in an exhibit with a lack of stimuli and no chance to learn behaviors natural to the species until 2021.

This particular baboon is a very inquisitive and highly active animal. He was exposed to many environmental stimuli that he could not control, which were perceived as threats. Due the lack of other individuals and the opportunity to socialize, he tended to become bored easily and expressed stereotypic behaviors.

Figure 1. Güero” the Hamadryas baboon.

Old Enclosure

This old enclosure was formed by means of two separate areas. The first one was an exhibit (6 meters wide x 10 meters long x 5 meters high) composed of two interconnected rooms, with three brick walls and one wall with welded wire mesh as the main visitor viewing area. It was completely roofed with wood and plastic tiles (Fig.2). The second area is the dormitory, which had concrete floors and welded wire mesh as the walls and roof, without a visual barrier (Fig. 3). Both areas were connected by a gate with a manual mechanism controlled by the keeper.

The furniture of the exhibit was simple, with a few logs for climbing and resting, granite dust as substrate, a metal container as water source, and a wooden house in the dormitory.

Figure 2. Frontal view of the old enclosure

Figure 3. The old enclosure dormitory

New Enclosure

It is a space of 8 meters wide x 8.60 meters long x 10 meters high, with a rocky area for climbing, a small rock house at the top, and a concrete water source connected to a motorize water fall. The main substrate is a mix of sand, black soil and granite, and there are some logs for climbing and resting (Fig. 4). The night house is a space of 2 meters wide x 6 meter long x 2.10 meters high with a fire hose bed and a hammock, a wooden latter with three levels for resting, and a concrete floor (Fig. 5). Both areas are connected by a metal gate controlled by pulley system.

The enclosure was built with a steel structure covered with galvanized high tensile wire mesh and corrugated metal roofing sheets on top. The dormitory also has metal sheets as walls.

Figure 4. New enclosure.

Figure 5. New enclosure dormitory.

Keepers

Since the 2019, two middle aged biologists, Stephanie Vargas and Antonio Romero, have been in charge of the daily care routine, maintenance of the exhibits, and the enrichment and training of some of primates in the zoo, including the single male hamadryas baboon.

Transport Cage

It is a wooden box (62 cm wide x 126cm long x 55 cm high) reinforced with steel structure. The inside of the box is covered with aluminum sheets and the floor is a rigid gym sponge. On both sides are two guillotines (62x68 cm) with a steel structure and are reinforced with iron bars and mesh. Both walls of the cage have six drilled holes (4 cm diameter) covered with iron mesh for air circulation (Fig. 6).

Figure 6. Transport cage.

Behavior Analysis

The very first ethogram analysis (2018) helped to define the most represented behaviors according the conditions of how the animal had been kept before the enrichment and training programs were created. The ethogram protocol was to record behaviors during 10 minute observation periods for three sessions each day, over a 10 day period of time. The scans were done as often as necessary to determine the amount of behaviors deployed (Table 1. Hamadryas baboon behavior chart).

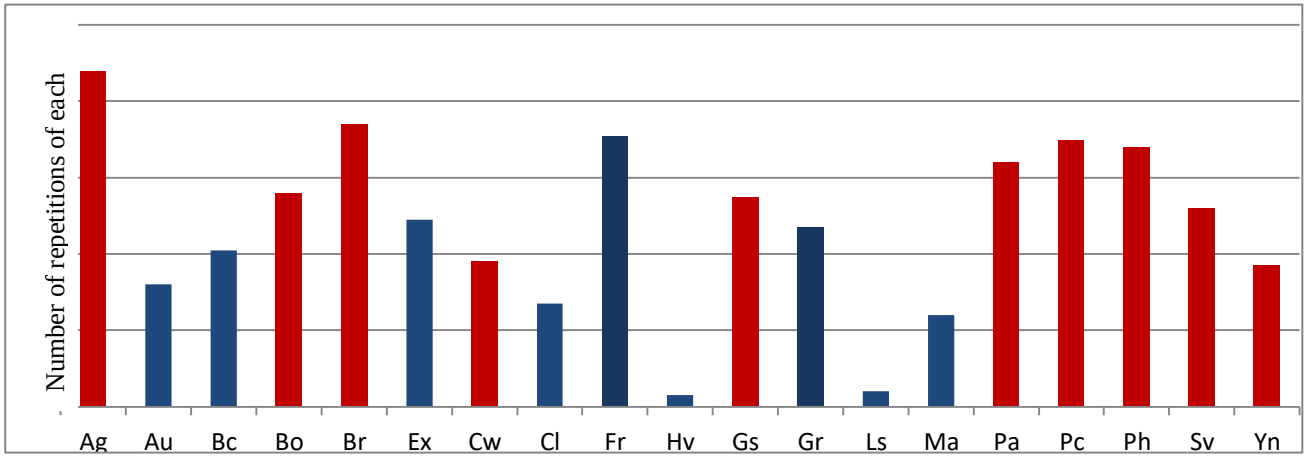
Behaviors		Description
Ag	Aggression	Violent movements against keepers or visitor, such as throwing dirt, sand or small rocks.
****Af**	Aggression against furnitu	Violent movements against furniture of the exhibit or toys equivalent to the animal's size
Au	Autogroom	An individual picks through their own hair or picks at fingers, toes or other body parts.
Bc	Bahuu call	Loud alarm bark sounding like "bahuu" or "wahoo".
Bo	Biting on shoulder, tail or leg	An individual bites itself; a frustration behavior.
Br	Brow raising	Individual stares at and raises eyebrows at other, such as keepers or visitors; an aggressive behavior.
Ex	Explore	Passive (visual) or active (moving) exploring surroundings.
CW	Circle wiping	Individual makes a one handed vertical circle movement in front of the nose; means frustration when an event does not go as expected.
Cl	Climb	Individual climbs up on rocks or climbing structures.

Fr	Forage	Individual actively searches for, eats, and masticates food; includes drinking.
***Hv**	Happy vocalization	A repetitive guttural vocalization made when the animal feels satisfaction with something in the exhibit or with enrichment.
Gs	Ground sweeping	Individual, sitting or standing, begins to rapidly sweep at surrounding substrate. Observed when an individual is displacing frustration.
Gr	Grunt	Vocalization made when an individual is excited or is anticipating something favorable.
Ls	Lip-smacking	An individual´s audible, rapid opening and closing of the lips, the tongue touching the lips; an affiliative behavior.
***Ma**	Masturbation	Behavior observed when an individual is displacing frustration or boredom.
***Pa**	Passing	Repetitive movement following the same path during an extended period of time.
Pc	Pumping cheeks with chewing movements	An individual is puffing cheeks and staring at someone who represents a threat.
***Ph**	Pulling hair	An individual aggressively pulls the hair from his forehead.
****Pt**	Patrol	Surveillance movements at different points in the exhibit
Sv	Scream vocalization	A vocalization made when an individual feels a threat .
****Sx**	Sexual behaviors	Individual expressing dominance and sexual intentions with toy and furniture.
Yn	Yawn	Individual yawn towards keepers or visitors, displaying canines.

Table 1. Hamadryas baboon behavior chart based on the 2020. AZA Baboon species survival plan. Hamadryas baboon care manual.*Including specific behaviors observed in this individual. ** New behaviors observed in the new exhibit.

The three daily data sessions were done in the morning (9 am), noon (12 pm) and afternoon (3 pm), when the zoo was open and closed to the visitors. The data was analyzed and classified by the number of repetitions of each behavior.

This first data results shown several repetitions of stereotypic behaviors, such as aggression against keepers and visitors (Ag),"bahuu" call (Bc), brow raising (Br), circle wiping (Cw), ground sweeping (Gs), passing (Pa), pumping cheeks with chewing movements (Pc), pulling hair (Ph), scream vocalization (Sv) and yawn (Yn). (Graphic. 1)



Graphic 1. Representation of the most common behaviors observed in the Hamadryas baboon initial ethogram. Red bars mark the stereotypic behaviors observed.

Environmental and Animal Enrichment

After the first behavioral data analysis, a program was developed to increase the opportunities that the animal had to express natural behaviors, create a more challenging habitat in line with the natural and individual history of the species, and to diversify the amount of activities for the animal to improve baboon welfare. (Table 2. Enrichment catalog). This was accomplished through the medical and enrichment departments consulting the established care manuals for Hamadryas Baboon welfare (Wiley, 2020; Turner, 2009 & Brent, 2005), budgeting for acquiring materials, such as available recyclable materials, and their considering of limits with infrastructure and the zoo's location.

Enrichment	Category
Burlap sack with hay/dry leaves, dry food, seeds and tubers.	Co, Ph, Se and Al
Bamboo drilled tube containing seeds.	Co, Sen and Al
Giant tub with hay and natural essence (basil, rosemary or mint).	Sen, Ph
Boomer ball® (20 in) drilled or complete. With dry food or natural essence.	So, Al and Ph
Large logs with drilled holes stuffing smashed fruit.	Ph, So and Al
Holes in the ground containing dry ficus leaves with hidden treats and daily diet.	Ph, Co and Al.
XL Kong® toy stuffed with smashed fruit and seeds.	Co, Sen and Al
Fire hose hammocks and platforms at different levels.	Sen and Ph
Paper craft envelops with diet hidden in different points.	Co, Sen, Ph and Al
JW Pet® Good cuz rubber dog toy, size: large.	Sen and So
Ice cubes with fruit.	Sen, Cog and Al
Logs of different size for climbing and exploration.	Ph
Long logs with drilled holes stuffing smashed fruit, seeds or natural essence (basil, rosemary or mint).	Ph, Sen, Cog and Al
Dry leaves beds (Ficus, bamboo and acacia).with fruits, tubers and dry food.	Sen and Ph
Burlap pillows with hey and natural essence (basil, rosemary or mint).	So, Ph and Co
Chopped diet scattered at different hours during the day.	Al and Ph
Plastic fruit crates hung on the mesh of the dormitory containing hay, fruits, seeds, dry food, and treats.	Al, Co, Sen and Ph
Cardboard boxes or piñatas with hay and natural essence or mix of seeds with fruits.	Al, Co, Sen and So
Fresh browse, acacia, bamboo, palm tree, ficus and grass.	Ph, Se and Al
Mud during hot seasons.	Sen and Ph
Whole Coconuts	Co and Al
Presence of the keepers in front of the mesh while the animal is foraging	So

Table 2. Enrichment catalog with the most accepted and successful items during the interaction with the primate. Categories So: Social, Co: Cognitive, Ph: Physical habitat, Se: Sensory and Al: Alimentary.

The most representative enrichments were those which offered the chance to forage, explore, climb and rest in comfortable places (Examples, Fig. 7,8,9,10 and 11).

Figure 7. Burlap sack with hay/dry leaves, dry food, seeds and tubers.

Figure 8. Dry leaves bed (Ficus, bamboo or acacia).with fruits, tubers and dry food.

Figure 10. Bamboo drilled tube containing seeds

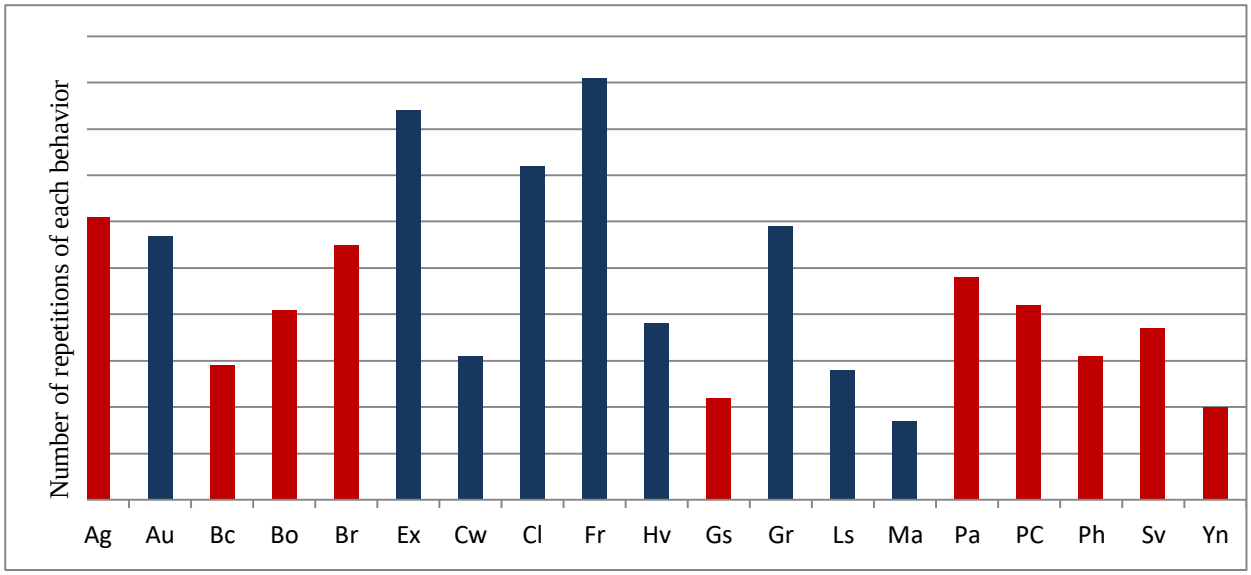
Figure 9. Fresh acacia browse.

Figure 11. Fire hose hammocks and platforms at different levels.

The enrichment was offered twice per day: during the morning in the dormitory while the enclosure was being serviced and in the afternoon.

The enrichment and operant conditioning programs were developed with specific goals, plans, and protocols. The focus of this specific case was the single individual that had been living in solitary conditions and to take into consideration his individual history, the natural behaviors observed in the wild, and the quantity and quality of stimuli offered during his first years at this institution. These programs ensured that all enrichment devices and training sessions were safe and presented on a variable schedule to prevent habituation and/or frustration.

After two months of consistent offering of enrichment activities, the data showed an animal with a large amount of natural and positive behaviors, along with an increase in the time invested in such behaviors. Although less frequent in occurrence, some stereotypic conducts continued to occur. (Graphic. 2)



Graphic 2. Representation of the most common behaviors observed after two months of enrichment activities. The stereotypic behaviors were still occurring, but were less frequent.

Transition and Acceptance of New Keepers

The first Hamadryas baboon keepers, were two men that had been taking care of him from 2011 to 2018. After some administration changes in the keeper organization, these keepers were switched, and Stephanie Vargas and Antonio Romero, who were mentioned above, took over. The process was slow to ensure that all safety measures took place and to promote good acceptance of the new staff.

It is important to mention that before this transition, both biologists had already been responsible of the enrichment department of this zoo. So, the Hamadryas baboon's acceptance of his new keepers was easier

because he got used to their presence and recognized that they were responsible for bringing him the enrichment items each day. Despite this degree of habituation to the biologist responsible for the enrichment, changing the daily maintenance and feeding routine still required a gradual acceptance.

In addition, the keepers were working on the habituation and confidence of the baboon to remain comfortable in the dormitory area with no access to the exhibit, so that keepers could service the enclosure. At the beginning, a large amount of enrichment needed to be offered while the animal was in the dormitory area to promote the animal to be calm, patient, and feel safe in the dormitory space. While the animals showed signs of patience, such as satisfaction postures and vocalizations, small pieces of bread with peanut butter were offered as reinforcement.

At the start of the daily enclosure servicing and the entrance to the dormitory, the baboon had to be persuaded into the dormitory area by calling his name and being reinforced with a piece of bread with peanut butter or banana. This command eventually became the emergency recall.

While the animal was displaying positive behaviors during the servicing routine, the enrichment being offered decreased in only part of the animal's diet and positive reinforcement offerings. As such, the major enrichment items were offered in the exhibit area.

The next step was to reinforce the recall at different times during the day, without keeping him inside the dormitory.

After few months of habituation to the new keepers, the hamadryas baboon had total trust with them, by showing acceptance, positive reactions to remain in the dormitory, and the increase of natural behaviors. In addition, there was a decrease in stereotypic behaviors, such as aggression against visitors, aggressive gestures against keepers, pulling hair and biting limbs.

Training for Transportation

The hamadryas baboons are very curious primates but also very protective with their own kind and their territory. Because of this, the presences of new or unfamiliar structures or furniture had to be presented in a gradual process, in order to create confidence and comfort sensations with the new items to the enclosure.

The training was carried out for 16 weeks. Training began with the presentation of the transport cage from outside the dormitory so that the baboon could get used to it. Gradually, the transport cage moved closer to the dormitory and then into it. It took four weeks for the baboon to habituate to the cage being a part of the regular enclosure furniture.

Enrichment items were offered, and the training focused on conditioning the animal to stay inside the transport cage. During this conditioning, the baboon was allowed to get out of the transport cage if it felt uncomfortable (Fig 12). After four more weeks, the baboon responded to the recall training and entered the cage in a comfortable and calm manner.

The next training step took eight weeks and consisted of keeping the baboon inside the fully enclosed transport cage, while reinforcing the baboon for calm behaviors (Fig 13). The primate reached 15 minutes of permanence without the displaying sings of aggressiveness, fear or discomfort.

Throughout the training, the reinforcements consisted of the keeper´s voice and bread with peanut butter and banana.

Figure.12.Working on the trust to get into the transport cage. A cardboard box containing daily diet and hay was offered as enrichment.

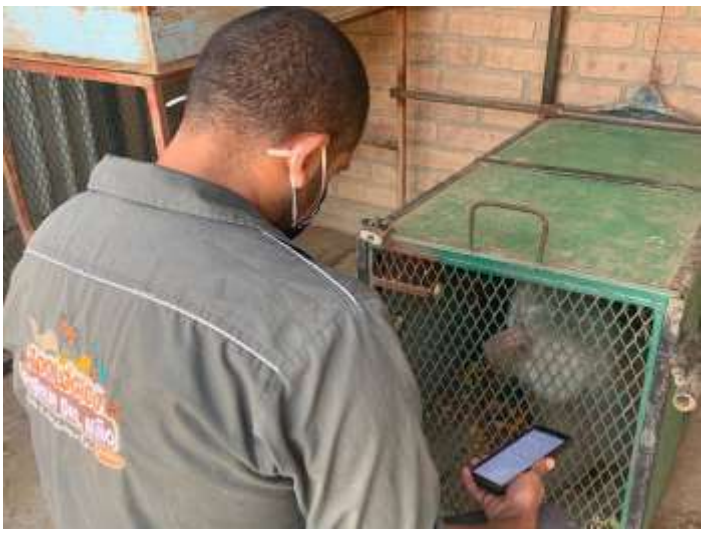


Figure13.Counting the time the baboon remained comfortable in the transport cage. A piece of bread with peanut butter was offered as reinforcement every 90 seconds.

Transfer Day (2019)

The day began as normal, with keepers striving to avoid any kind of uncommon actions that may provoke menace or nervousness from the baboon. Only the routine keepers were present at the primate view. The veterinary team and support team were close by, but not in animal´s range of vision.

The training session began as normal, but no diet or enrichment were offered. The recall was done and the baboon got inside the transport cage successfully, while the other keeper stood on the top of the cage, in charge of pulling down the second guillotine door. The animal remained locked in the cage, while the whole team came to help move the cage and put it on a truck (Fig.14). The team then lowered the transport cage and attached it to the dormitory gate and released the animal into the dormitory area (Fig.15). The transportation occurred in only 12 minutes.

Figure 14.Veterinarians and keepers supporting the baboon transfer.

Figure15.Releasing the animal in the new enclosure dormitory

New Enclosure Habituation

The animal entered the dormitory very quickly after the guillotine was opened. He showed curious behaviors, but displayed some signs of fear due to the presence of the whole keeper team. Only the primary keepers for the animal stayed to monitor his behaviors after the transport was completed. The dormitory was enriched with a fire hose hammock and a platform, a wooden stair, hay as substrate, and some ficus branches with the diet hidden in it.

The baboon stayed in the dormitory for four days, while he was adjusting to this new space.

On the morning of the fifth day, he was released into the exhibit. The first behaviors observed were exploring, curiosity, foraging, climbing, smelling and becoming familiar with every inch of the area. He also exhibited aggressive behaviors such as, kecking, loud “ba-huu” call, brow-raising, and pumping cheeks with chewing movements (Wiley *et al*., 2020). The motives behind these behaviors were new animal neighbors,

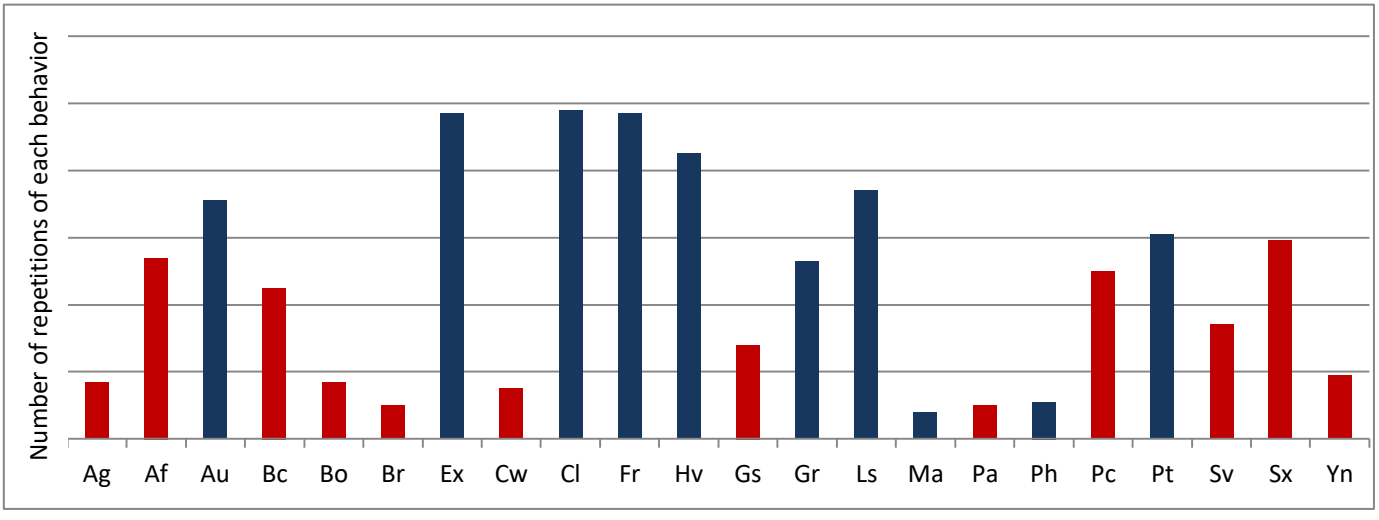
including a couple of patas monkey (*Erythrocebus patas*), one male dromedary (*Camelus dromedarius*), a small herd of Nilgai antelope (*Boselaphus trogocamelus*), and a picnic with swimming pools area.

In spite of the close proximity of new animals, the baboon showed confidence exploring and recognizing the exhibit and dormitory, selected areas for resting, carried out surveillance, and established patrolling patterns. During this process of habituation, enrichment was offered less frequently because the veterinary department, keepers, and enrichment department thought the new habitat provided enough stimuli for the animal. Keepers continued to train the recall behavior of the animal into the dormitory area to allow keepers to service the enclosure. The operant conditioning remained successful through showing a positive response from the animal with relaxed behaviors in the dormitory.

In times of major maintenance activities in the exhibit, more stimulating enrichment was offered in the dormitory, but after a few minutes, the baboon would express behaviors such as pulling his tail, biting shoulder and chasing one leg. These behaviors were indicative of the animal having anxiety to be released and lacked control of his environment. The keepers had to once again begin to reinforce calm behaviors while the habitat had been cleaned.

Because of the size of the new exhibit, the enrichment activities increased, creating a more challenging habitat with logs, platforms, and a wide area for different substrates and spots for hiding food and treats.

After almost a year in the new exhibit with an increase in the amount of enrichment activities offered, the data showed an animal with a major number of natural behaviors, such as autogroom (Au),explore (Ex), climb (Cl), forage (Fr) ,happy vocalization(Hv), grunt (Gr), lipsmack (Ls) and patrol (Pt). (Graphic.3)



Graphic 3. Representation of the most common behaviors observed after a year of enrichment activities in the new exhibit. The Hamadryas baboon present new conducts, like aggression against furniture, patrolling and sexual behaviors with furniture or toys of the animal's size.

Discussion

Since the start of this project in 2018, the behavioral data analysis has shown great progress in the mental and physical health of the hamadryas baboon. The constant implementation of the enrichment and operant conditioning program has helped to reduce the frequency of stereotypical behaviors and, in turn, has increased the repertoire of natural behaviors according to the ecology and biology of the species.

In addition to the above, the exhibit transition and habituation have allowed behaviors to be recorded that had not been observed before. Such behaviors include: patrol, selective use of the habitat, rest, vigilance, exploring and feeding, better use of space, an increase in comfort and calm behaviors in front of the visitors viewing areas, and having less frequent aggressive reactions towards visitors and the keepers.

This change in exhibit allowed behaviors to be recorded that the baboon would normally display with other baboons, such as aggressiveness with the habitat furniture or toys similar to the animal's size. This could indicate that the primate was trying to establish dominance against these items. Despite the animal's expression of sexual behaviors and display postures and gestures to indicate reproductive intentions, it can be inferred that the animal has a need for social interaction with individuals of the same species.

The baboon has become habituated to both keepers and has accepted both of them. However, he has been observed carrying out more affiliative conducts with the male zookeeper. These behaviors include: lip-smacking and bending elbows and knees while standing, which could possibly be submissive conducts, but more data needs to be gathered and an analysis has to be done. In addition, the baboon has shown aggressive behavior while the zookeepers are carrying out the servicing routine with the support of other keepers and unknown people, principally men. We can assume that the baboon considers the keepers to be as similar as possible to individuals of its group.

Conclusions

- In spite of a diverse enrichment catalog, the lack of more individuals limits the behavioral development of the primate. That is the reason why the zoo is working in collaboration plans with other institution to establish a small hamadryas baboon group.

- As part of the daily activities for animal welfare, the operant conditioning program continues and the enrichment catalog is increasing.
- The habituation to the new exhibit helped the baboon to express a major number of natural behaviors. However, aggressive reactions were also recorded against logs, rocks, furniture in general and with toy of the same size of the animal which implies the deployment of social conducts that this baboon may show with other individuals.
- The location of the new habitat is between two pools for visitors and is alongside a very busy path. It is important to develop an environmental educational program to discourage people from catching the primate's attention, disturbing him, or offering him any kind of food.

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- **Items**:
  - Kong company. 7 High post business park. Salisbury, Wiltshire SP4 6AT, United Kingdom. www.kongcompany.com
  - Boomer ball. www.boomerball.com Telephone: (847)-546-6125
  - JW PET Company Inc. 2300 E Randol Mill Rd, Arlington, Tx 76011. www.petmate.com

Training the Herd, Not Just the Cow

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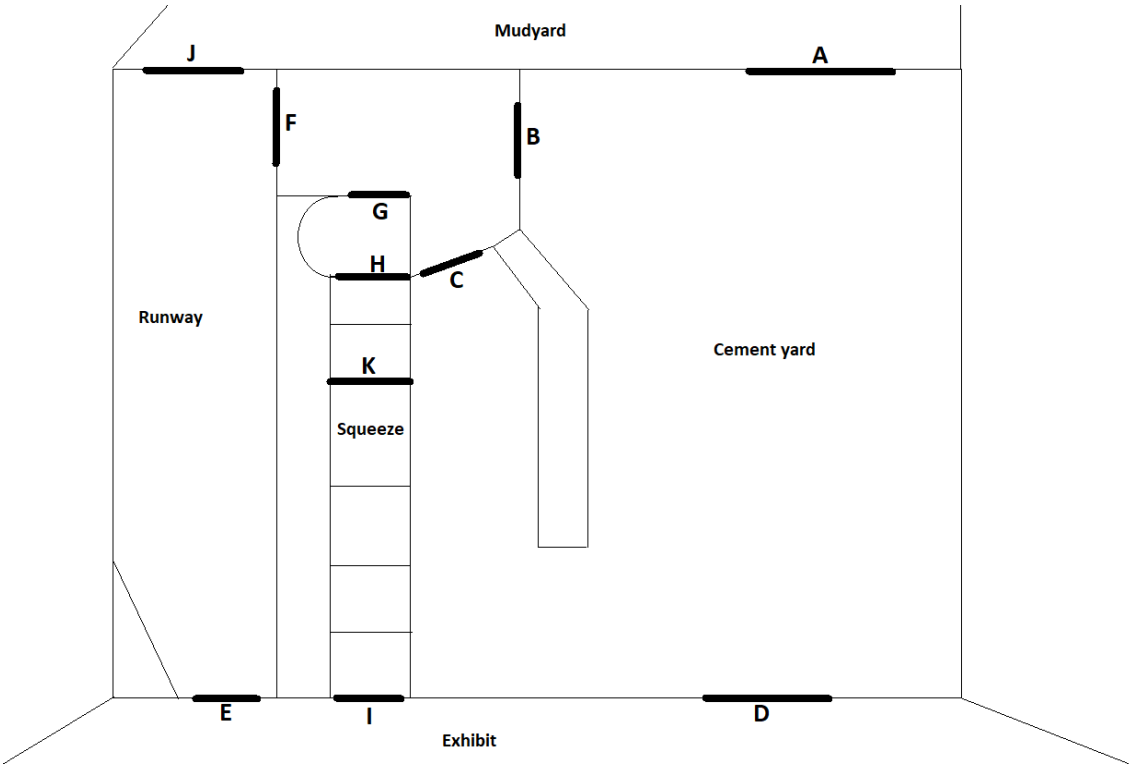
Wood bison (Bison bison athabascae) are the largest native terrestrial mammal in North America (Environment and Climate Change Canada, 2018). During the 1800s, wood bison numbers were estimated at 168,000 but by the late 1800s had decreased to only a few hundred. This reduction in bison was due to over hunting, changes in distribution of habitat and severe winters. In the mid 1920s, plains bison were translocated to Wood Bison National Park where they interbred with the wood bison. This translocation introduced two cattle diseases (bovine brucellosis and bovine tuberculosis) to the population (Environment and Climate Change Canada, 2018). These two diseases pose the biggest threat to the wood bison recovery. This species was listed as threatened under the Species at Risk Act in 2003 (Environment and Climate Change Canada, 2018). With only approximately 8,587 free ranging bison left in Canada (Environment and Climate Change Canada, 2018), conservation efforts from institutions such as the Toronto Zoo are very important. The Toronto Zoo has been involved in wood bison conservation since 1977, with captive breeding and the reintroduction of animals back into the wild.

Over the last 13 years, along with the University of Saskatchewan, the Toronto Zoo has been doing research on advancing assisted reproductive techniques for wood bison. The reproduction team at the zoo have been working on advancing reproductive technologies including artificial insemination and embryo transfer. This research is very important for the genetic management of this species in the hopes of restoring genetically diverse and disease-free herds into the wild. In order to proceed with this research, every fall the herd of female bison are required to go off-display from their habitat and into a cattle handling system. Here they would go one by one through the chute and into a squeeze. Once in the squeeze, the bison would be in a fixed position allowing the veterinarians, technicians and other researchers safe access to the animal. Staff would then administer vaccinations, hormone injections, ultrasound and possibly impregnate the bison. The previous process of getting the bison into the chute was stressful for the herd. In order to get the entire herd into the area where the handling system was located and into the system itself, the bison would be corralled using vehicles and human presence. This process increased the stress of the bison where running, panting and intraspecies conflict was seen. This process was also potentially dangerous for the humans corralling the animals on foot due to the sheer size and speed of the running bison. Additionally, stress is linked to poor reproductive outcomes and thus would be counter-productive for the purpose of handling them (Fernandez-Novo et al., 2020). In 2018, we started a multi-phase training program that consisted of training the herd as a whole, with the goal of each bison voluntarily entering the chute thus eliminating aversive practices. This would not only decrease the stress of the animals but would also increase safety, and allow for a smoother and more efficient processing experience.

Method

A 5-phase plan was devised that required the entire bison herd to shift off exhibit and into the back paddock (referred to as the mudyard) where the handling system was located. In the past, this area was off limits until right before the first catch up. Since it was usually vacant, this back area would become lush with grass and the curiosity of the bison would get the better of them, thereby encouraging them to shift. The plan required the entire herd of bison to voluntarily shift into the mudyard each day using a whistle as a cue and produce (mostly apples and carrots) as a reinforcer. The bison would be locked out of this back area except during training. The daily steps were as follow:



Phase 1:

Step 1: Open door **A, B, C**
Step 2: Open door **D,** drive truck forward blocking entrance from exhibit into cement yard (Through door **D**)
Step 3: Place training food (apples, carrots and some herbivore cubes) in the back of the mudyard.
Step 4: Blow the whistle 3 times and reverse the truck back onto exhibit.
Step 5 Shut door **D** after ALL bison go through into the cement yard.
Step 6: Place the remainder of the food on exhibit (close to the training area)
Step 7: Open door **D** to let bison back on exhibit, once all bison leave area on their own close door **D** and leave the paddock.
Step 8: Record how the session went in the bison binder. Once all animals are regularly following all the steps comfortably move to phase 2.

Phase 2:

Step 1: Open door **A, B, C**
Step 2: Open door **D,** drive truck forward blocking entrance from exhibit into cement yard (Through door **D**)
Step 3: Place training food (apples carrots and some cubes) in the back of the mudyard.
Step 4: Blow the whistle 3 times and reverse the truck. Shut door **D** after ALL bison go through into the cement yard.
Step 5: Place the remainder of the food on exhibit (close to the training area)
Step 6: Open door **E,** then open door **F** and blow whistle 3 times all while standing on the catwalk.
Step 7: Give the bison enough time to go through the tub, the runway and out onto exhibit. If there are any stragglers let them out of door **D.**
Step 8: Record how the session went in the bison binder. Once all animals are regularly following all the steps comfortably and all going through the runway out to the exhibit, move to phase 3.

Phase 3:

Step 1- 5: As in phase 2
Step 6: Open door **G, H,** and **I** then blow whistle 3 times, all while standing on the catwalk.
Step 7: If bison are reluctant to go through step down from catwalk and potentially move further away to allow the bison to move comfortably through the chute.
Step 8: After giving the bison adequate time to go through the chute, if there are any that are reluctant to go through close doors **G**, **H**, and **I** then open **E** and **F** to let the stragglers out.
Step 9: Record how the session went in the bison binder. Once all animals are regularly exiting the training area through the chute with you on the catwalk, move to phase 4.

Phase 4:

Step 1- 5: As in phase 2
Step 6: Open door **G, H,** and **I** then blow whistle 3 times while standing on the catwalk.
Step 7: Start by having door **K** closed and when bison enters the chute close door **H** behind them. Wait 5-10 seconds then open door **K** and let them out. Time can be increased based on how calm the bison is.
Step 8: After giving the bison adequate time to go through the chute, if there are any that are reluctant to go through with the door closed, step down from the catwalk, blow your whistle and let the rest run through the chute.
Step 9: Record how the session went in the bison binder. Once all animals are regularly being stopped in chute while remaining calm, move to phase 5.
*Some bison may move to phase 5 while others are not ready yet.

Phase 5:

Step 1- 7: As in phase 4

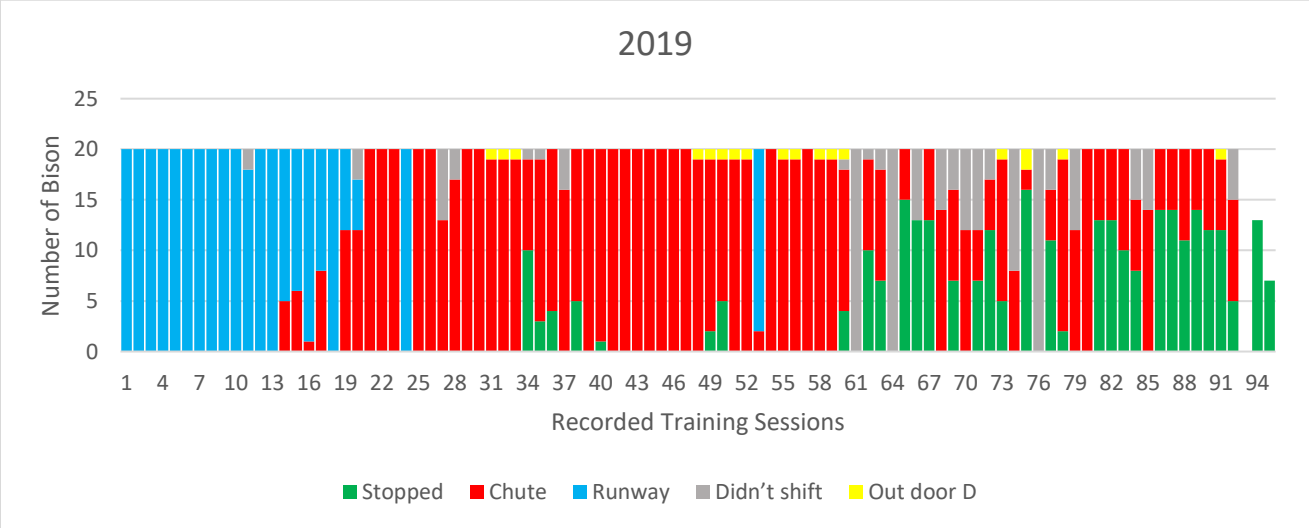
Step 7: Instead of letting the bison run out of the chute after being stopped, move them into the next section that has the squeeze. Squeeze the bison gently and hold for 5-10 seconds, then release them through the chute.
Step 9: Once comfortable in squeeze you can add the stanchion.
Step 10: Slowly increase the animal's time in the squeeze and eventually add tactile training.
Step 9: Record how the session went in the bison binder.

Results

2018

In the fall of 2018, the bison underwent five catch ups in order to participate in the reproduction study. It was after the first few catch ups that it was decided we needed to come up with a better way of managing the herd. Since we were in the midst of catch ups our goal was to work on, and possibly complete, phase 1. When we started the new plan, the herd consisted of 14 females with 6 new younger females being added in mid-November before the final catch up. After a few days of them being given access to the cement and mud yard, with staff present, they quickly caught on to the favourable food being located there. They would then shift off exhibit allowing us to lock them in the back by closing door D. We could then put the remainder of their diet on exhibit and let them back out to eat. Although we made some progress with getting the bison to voluntarily shift off the exhibit, human presence was still needed to corral the bison into the chute. As a result, we did see some intraspecies conflict between the bison with a few that ended up with gore wounds. One bison had to be sedated and stitched up.

2019



We started up training for the season in April of 2019, with our herd still at 20 females. The herd was given access to the cement/mudyard daily. By May we had them consistently shifting off exhibit and we moved onto phase 2.

Sessions 1-13: These sessions pertain to the first three weeks of May, when we first started phase 2. We opened the doors to the back runway after locking the bison off exhibit. The first day, it took them about 30 minutes to realize the doors were open for them to use the back runway as a route back to the exhibit and their food. The next few days they were a lot faster and all shifted back onto exhibit within a few minutes.

Session 14-33: By the last week of May we decided to move to phase 3 where we closed the back runway and opened up the chute. The bison were very hesitant to go through especially with staff up on the catwalk. All staff stepped down and away from the chute. On the first day, we had 5 go onto exhibit via the chute after about two hours. We decided to call the session after giving them an hour to eat their produce and then move through the chute. As the sessions went on more bison were using the chute as a means to get back on exhibit. On June 1st (session 21) the entire herd shifted out of the back via the chute.

Sessions 34-61: These sessions took place from the last week of June until mid-August. We decided to move to phase 4 where we would slow the herd running through the chute and stop them in the sections prior to the squeeze portion of the chute. We did not have the opportunity to try stopping them every day during this period. Since this training process was particularly time consuming, there were many days in the summer (due to staff on vacation) that we didn't have the time to put towards stopping them in the chute. On days that we were at minimum staffing levels we made sure to at least shift the bison to the back and then let them back on exhibit via the chute. There were also a lot of days that the bison weren't motivated to shift. The days were quite hot and since they lived in a very large paddock with grass to eat, they weren't always willing to shift for the apples and carrots.

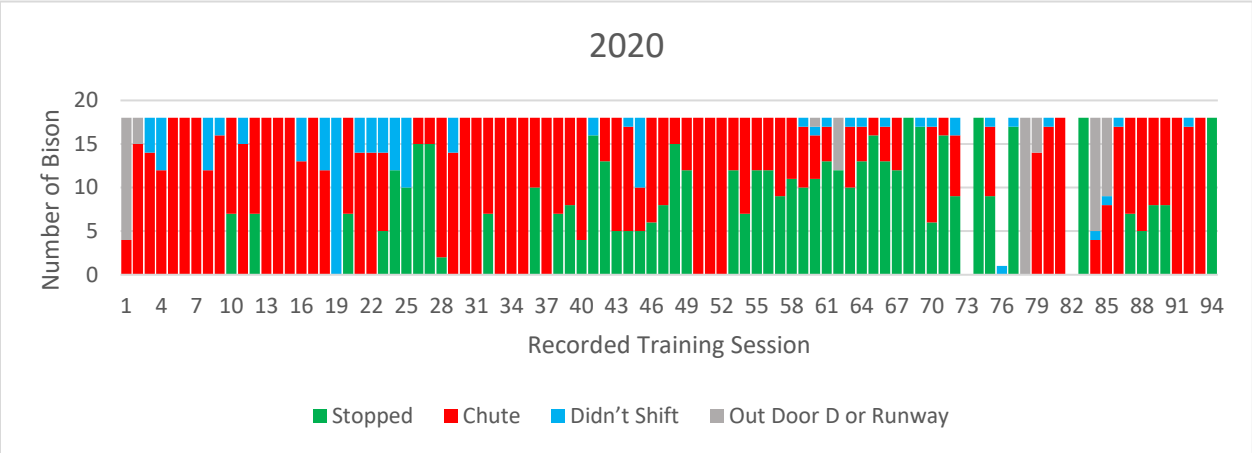
Sessions 62-95: These sessions went from mid-August until the end of October. We were more consistently stopping the bison leading up to the catch up. Near the end of September, we also started closing door A, allowing only a small group of 5 or 6 bison into the cement yard at a time. This was to prepare for catch up day where we only wanted a few bison at a time ready to enter the chute.

The reproductive studies were cancelled this year however, the vets still wanted to process the bison and vaccinate them. In session number 93, all bison were shifted off exhibit and kept in the back overnight so the vets could process them first thing the next day. In session number 94, only 13 bison wanted to participate and were stopped and processed in the squeeze. The vets came back the next morning to process the remaining 7 bison. All 20 bison entered the chute system voluntarily. Very few bison had to be coerced from chute to squeeze by negative reinforcement (Claps, stick prodding, loud noise etc.) With only processing five or six at a time there was very little intraspecies conflict and none of the bison had to be treated for gash wounds.

There was one bison that was 22 years old that had cataracts and therefore some vision problems. She would often follow along with the herd and shift off exhibit and sometimes would follow them out the chute. There were also many days she would not follow them out the chute so we

would simply let her out door D onto exhibit after the rest were shifted back. This bison along with another older female were euthanized due to age and health status in November.

2020



Our training started at the beginning of May with our herd now consisting of 18 females, all which would be participating in the reproduction study in the fall.

Sessions 1-22: These sessions went from the beginning of May until the first week of June. Our focus was to get the bison once again used to shifting off exhibit and then back again through the chute. Since they were a little out of practice from the winter hiatus, only a few bison went back onto the exhibit via the chute during the first session. The remaining bison had to be let out the back runway. They quickly caught on and the bison that shifted back would all use the chute to go back on exhibit. Throughout this block of sessions, there were a couple instances where we attempted to stop them in the chute if the bison appeared calm and we had sufficient staffing levels to dedicate to bison training. These instances resulted in 39% of the herd successfully being stopped. Overall, 45% of these training sessions resulted in all bison utilizing the chute to return to the exhibit and 91% of these sessions resulted in at least two thirds of the herd utilizing the chute.

Sessions 23-68: These sessions went from the first week in June until the first week of October. We tried to focus on stopping as many bison in the chute as we could during each session. Any session where no bison were stopped was due to not having sufficient staffing levels, or not enough time during the keeper shift, thus the bison were shifted out through the chute. Over the course of these sessions the number of bison that were stopped consistently increased. There was one bison however that consistently chose not to participate in training and remained on exhibit. We can break down the training sessions where bison were stopped successfully into two cohorts; early sessions and later sessions. We can see an average of 9 bison being successfully stopped in the early cohort based on 19 recorded training sessions. In the later cohort we can see that the average number of bison successfully stopped increased to 12, based on 17 recorded sessions.

Sessions 69-83: This session covered the remainder of October where we had the four main catch-ups (Sessions 69, 74, 77, and 83) for the reproduction study. Unfortunately, one bison didn't shift off exhibit during the first catch up and was therefore removed from the study. For the remaining three catchups, we locked the bison into the backyard the day prior to the catch up. After each of the first three catch ups we wanted to ensure that we trained them the next day. Of these three subsequent sessions, the 17 bison that were in the study shifted in the back. However, the day after the third catch up the bison wouldn't shift through the chute. They were not trained the day after the last catch up. In all four catch ups, all participating bison entered the chute system on their own accord. Also, it is important to note, the catch ups this year were completed in less time than in previous years. The second catch up was completed in around two hours. During the catch ups we only had a maximum of five or six bison waiting in the cement yard for their turn to go into the chute. The waiting bison were fairly calm and little to no intraspecies conflict was seen.

Sessions 84-94: These sessions were the first three weeks of November. We continued training the bison and tried stopping them when we could, in preparation for the final catch up (sessions 94), where all were successfully stopped and were given ultrasounds to check for pregnancies.

2021

This year we continued to shift the bison into the back daily and then shift them back onto exhibit via the chute. When time allowed, we stopped as many as we could in the chute system. Records were not kept as thoroughly as previous years as there was no real progression in the training. In the fall the catch-ups were successful and four bison were proven pregnant via ultrasound. Out of the four pregnancies, three calves were born in June of 2022.

Conclusion

Through consistent training with the bison entering the chute daily, we were able to achieve our goal of the whole herd entering the system on their own accord. As a result, our catch-ups involved fewer conflicts, animals were visibly calmer, and overall processing time to move animals through the chute decreased.

For the training to be considered a success the entire herd needed to participate. Since wood bison are a herd species they generally stayed together and would move locations as a group. On days that one or two bison chose not to participate, the following day more bison would choose not to participate. Since their diet was used as a reinforcer for leaving the training area/handling system, some bison held back in order to get the first access to the herbivore cubes and hay. We needed to troubleshoot this so that the bison that chose not to participate would still get fed, yet we reward the bison that did participate. We would start off each training session by putting the produce and ¼ of their herbivore cubes into the mudyard (if any more than that, it would take the herd too long to eat and we would have to wait a while before they would shift back onto exhibit). If the entire herd participated, we would put the remainder of the diet on exhibit for the bison to get once they shifted out. When one or more bison chose not to participate, we would put the rest of the herbivore cubes in the cement/mudyard area and come back in an hour to shift

the herd back onto exhibit. We would try once more when we returned to get the unwilling bison to go into the cement yard (with door A closed) before letting the herd through the chute. Since the hay was their main diet but also the least favourable, we would only put hay out on exhibit for the bison that didn't participate, but only after the rest of the herd shifted back out.

Another issue we had was when multiple bison would run through the chute really fast. To prevent creating a negative experience, whenever the bison were too quick and too close together, we didn't attempt to stop them in the chute, and would open the doors (H and K) to let them run through instead.

For safety purposes, we had to make sure to close the doors on both ends of the chute system when we were not present. This prevented the bison from using the chute when we were not there and from getting trapped within it. This also prevented the bison from going from the mudyard and into the chute before we were ready for them.

Restrictions to training included low staff numbers (especially during peak vacation season), weather (too hot, lighting storms and during winter), and when staff had prior engagements (other animal procedures, staff training, tours, etc.).

Diet was also a factor in the bison's ability to train. Since bison are principally grazers, they had access to food 24/7. We supplemented the grass in their paddock with hay and herbivore cubes. If they received too many cubes, they were unmotivated to train. If they received too few cubes they weren't as calm during the training session. We had to tweak their diet constantly to achieve the best results.

There were also male bison in a paddock adjacent to the mudyard. This posed a distraction for the females especially during breeding season. We found some of the females would prefer to stay in the back near the males instead of going through the chute. We moved the males from that paddock into another paddock to not only solve this problem but also to give the females more space if needed.

With continued efforts we hope to further desensitize the bison to the chute and squeeze mechanism within the system to further reduce the handling time and improve overall animal welfare.

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Rolling With It: Savanna Enrichment Renovation

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Abstract

We designed an enrichment program for our giraffe to increase randomization, diversity, and equal usage of categories that was simple, effective and allowed for growth. The program started with assessing what we had on hand and what we could modify to produce desired behaviors. We then implemented phase 1 of our program, which was a randomizer in the form of a dice set. Each face was labeled with a different type of enrichment including sensory, toy, foraging, and manipulation. We set a target of 4-5 different items a day, taking note of the items we used that day. We worked to avoid repeating those items within the week until all items had been used. As our program successfully expanded, we moved to implement phase 2 of our program. Our next stage was switching to a bingo ball machine that allowed for a larger library of items. We increased the amount of enrichment daily with the next phase and maintained the rule of using all items before repeating. Because of this program, all of our giraffe have become more resilient to change within their environment, more receptive to training, and overall a more cohesive tower. We are now working to expand this program into the rest of the savanna unit.

Introduction

When we first began in the savanna unit of Woodland Park Zoo, the enrichment program was minimal and limited for our two female Rothschild giraffe (Giraffa Camelopardalis) and our male Reticulated giraffe (Giraffa Reticulata). It consisted of a few 5-gallon buckets with holes cut in them and a few smaller buckets of the same design that were utilized to fill with romaine and give to the giraffe (Figure 1). Additionally, these items were used daily; consequently, variety was minimal and made each day rather routine. Together, we decided we were not only going to renovate the enrichment, but we were going to reimagine the entire enrichment program. We wanted to work towards enrichment that tapped into all the senses and did not just focus on food. Although a large portion of these animals' time is occupied by browsing/foraging

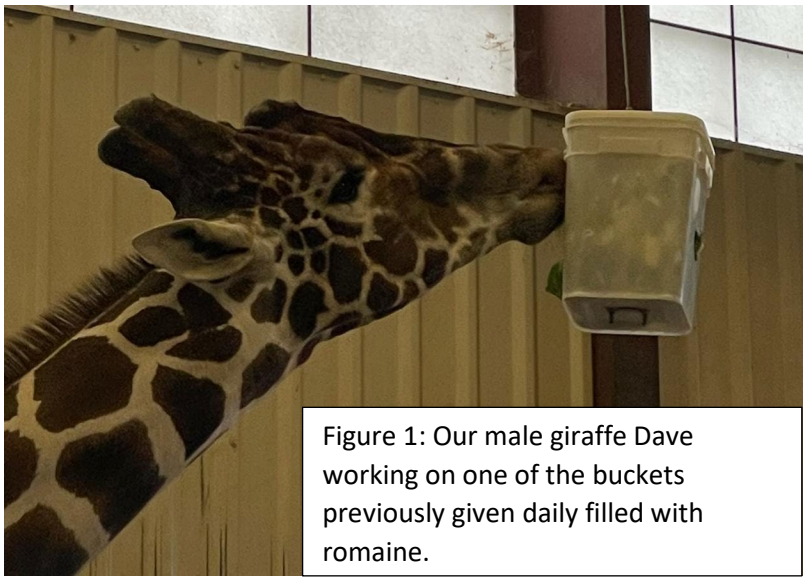


Figure 1: Our male giraffe Dave working on one of the buckets previously given daily filled with romaine.

for food, we really wanted to encourage other natural behaviors and interactions. Additionally, we really wanted to develop a system that would optimize randomization and try to avoid the same items from being used too often.

Getting Creative

Our process began by simply assessing what we had on hand. Fortunately, we had quite a few random materials that we were able to look at through a new lens and utilize to create new enrichment items. There were several factors we had to consider when assessing these materials to determine whether they would be suitable for enrichment. For example, we had to determine whether the materials were strong enough to withstand wear and tear from large hoofstock. As many zoo staff know, animals can be very hard on enrichment items so sturdy materials are always a top priority. Additionally, we had to evaluate whether it could be modified easily within our means to meet our needs. The items needed to be able to be modified using common tools such as a drill and hand saw. Lastly but certainly not least, was the finished product safe for the animals to have? Each item had to be submitted and evaluated by the keepers, management, and our animal health department to determine whether it was safe and appropriate for the animals it was constructed for. If the item met all the requirements through this process, we were then able to test it out with our target audience: the giraffe!

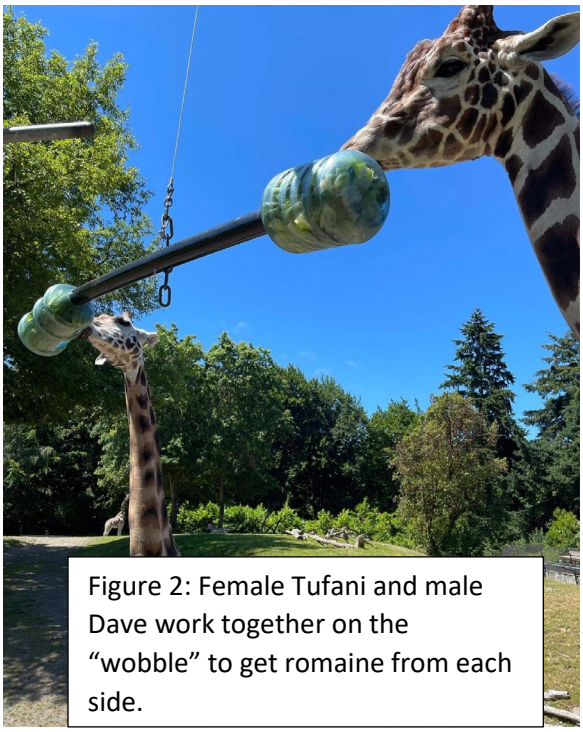


Figure 2: Female Tufani and male Dave work together on the "wobble" to get romaine from each side.

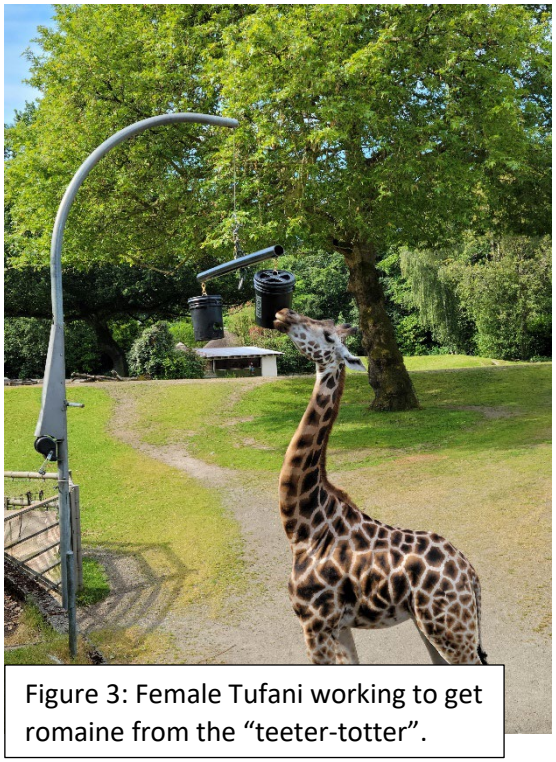


Figure 3: Female Tufani working to get romaine from the "teeter-totter".

Through this process, we were able to create numerous enrichment items through repurposed materials as well as modify old items and increase our arsenal of enrichment tenfold. We had several PVC pipes of different sizes that we were able to repurpose to create enrichment items such as our "wobble" (Figure 2) and "teeter-totter" (Figure 3) which happen to be some of the giraffes' favorite puzzle feeder items. We were also able to create sensory mobiles (Figure 4) that contain different items that feel or sound different. Some of these items were as simple as strips of firehose, large

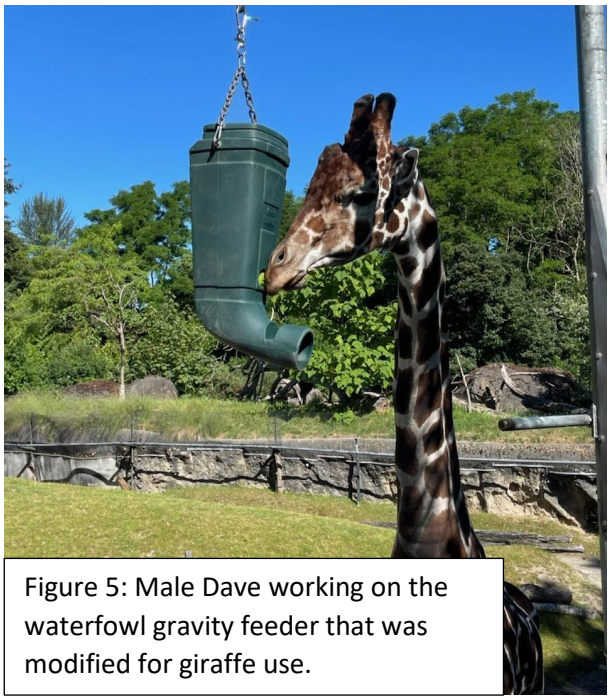


Figure 5: Male Dave working on the waterfowl gravity feeder that was modified for giraffe use.

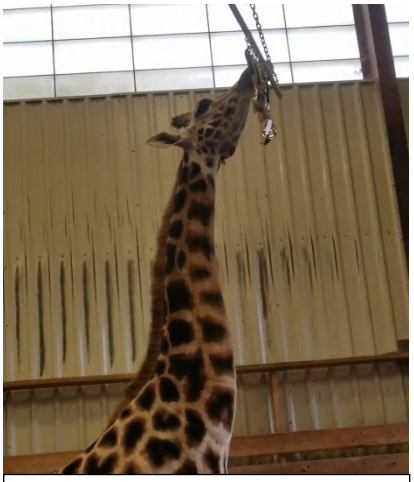
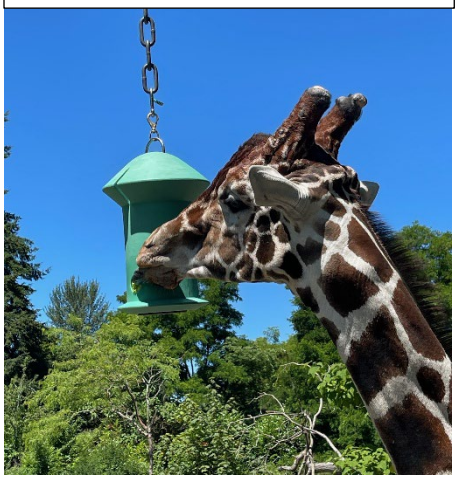


Figure 4: Female Tufani interacting with one of the sensory mobiles we created, this one being metal kitchen utensils.

metal kitchen utensils, and different broom heads. We also took the opportunity to take items that were intended and not being utilized for other species and modify them to be used for giraffe enrichment. One of the best examples of this is the waterfowl gravity feeders we had on hand (figure 5). The only modifications we made was simply making another hole in the feeder and attaching hardware to allow it to be hung up. These simple modifications allowed for various complexity and difficulty while allowing more than one giraffe to interact with it at the same time.

Figure 7: Our Landmine enrichment item with plastic bowling puns added to it to increase complexity.

Figure 6: Male Dave interacting with the Amazing Graze that has been modified to hang up.



Additionally, we were able to add some of the smaller items we had on hand in to other enrichment items to increase the complexity and difficulty. A great example of this was the plastic bowling pins and balls that had been stowed away in the giraffe barn for years. At first, we were a bit stumped on how to utilize these until we realized some of our puzzle feeders were becoming less of a challenge for our giraffe. At that point, it clicked; add these bowling pins and balls to our current puzzle feeders (Figure 6) to increase the complexity and engage the giraffe even further! This method proved very successful and increased the variation in our enrichment program even more. As our enrichment program advanced forward, we were also able to purchase some other enrichment items we could not

replicate ourselves and make small modifications to make them suitable for giraffe. Many of these items were designed for animals to have on the ground but with simple hardware, we had the ability to hang these items instead and allow the giraffe varying difficulties. A few great examples include the Amazing Graze™ (Horsemen's Pride 10008 State Route 43, Streetsboro, OH 44241, figure 6), the "rocket ship" (Stubb's England pony hay roller 11015 W Layton Ave suite A Greenfield, WI, 53228, figure 8), and the "landmine" (High Country Plastics 1502 Aviation Way Caldwell, Idaho 83605, figure 7). With just a simple U-bolt and clip, they were good to go!

Figure 8: Enrichment item we coined "the rocket ship" after being modified for giraffe.

Breaking the Pattern

As we expanded on our enrichment collection, we also wanted to devise a system that would encourage randomization among the use of the enrichment. Many of the systems used previously revolved more around an enrichment calendar. Unfortunately, this resulted in a predictable pattern of enrichment, almost routine. The decision was made to use four 6-sided dice with each face having a different enrichment item or category on it. This implemented randomization while still allowing for growth in our young program.

Figure 9: The "dice of decision" we created.

Once we had all our enrichment items on the dice, we still had some blank sides on some of them. At this point, we decided to incorporate different audio enrichment as well. This included music, white noise, and the audio of TV shows or movies. "Dealer's choice" was an option on a few of the dice, again to leave room for growth. These dice became known as the "dice of decision" (Figure 9). As we began using this system, we noticed that it not only engaged the giraffe exponentially more, but it also changed our way of

Figure 10: Our bingo ball machine we now use.

thinking when it came to presenting enrichment. It pushed us to be more creative and think of different ways items could be paired together or combined to create enrichment that is more dynamic on a daily basis.

With our growing collection of enrichment and our new system of choosing enrichment daily, the program was thriving. The more we utilized this system, the faster the creative wheels turned. Within just a few months of using the dice of decision, we had obtained and created more enrichment items than could fit on the dice. The dice had served us well, but it was time to move on to something bigger and better.

What could we use in place of the dice that would allow for a larger library of enrichment items and maintain the randomization we desired? A bingo ball machine! Each bingo ball coincided with an enrichment item, and we dispensed five bingo balls daily (Figure 10). This proved to carry on the randomization system we developed with the dice while continuing to leave room to expand on our enrichment catalogue. The machine has allowed us to use our items more equitably; the goal is to work our way through the entire collection before starting over again. Once we fill all 75 balls with a corresponding item, we will implement different colored bingo balls to continue our system of randomization.

Unexpected Benefits

Developing the system was an effort that required commitment from the entire team, but has proven to be one that gives us structure while encouraging growth. All three of our giraffe have become much more resilient to new items in their environment. Previously, even the slightest change in the barn or the savanna would throw their entire day off. Crossing them from the barn to savanna and vice versa was always a challenge with the varying number of guests present. If there was a stroller or something else slightly unusual, they would stop dead in their tracks. It would sometimes take over thirty minutes to get them to their destination despite them doing this nearly every day during nice weather. Additionally, if modifications or repairs had to be made in the barn, we had to strategize how we would make these changes less noticeable. Otherwise, the giraffe may not come back in to the barn for the night. This pattern of coddling and sheltering had gone on for many years causing these giraffe to be extremely sensitive to change.

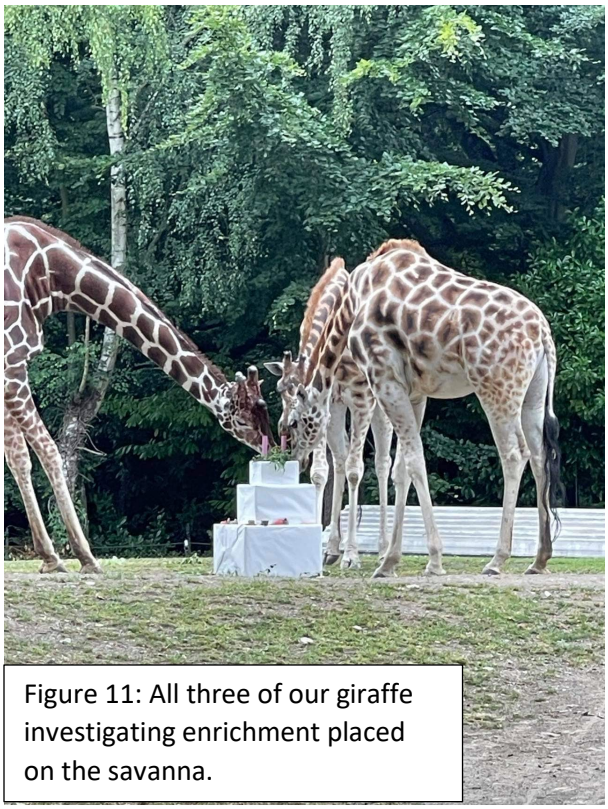


Figure 11: All three of our giraffe investigating enrichment placed on the savanna.

As we began introducing new enrichment items to their environment, there were some definite growing pains. Our male giraffe, Dave adapted a little more quickly as he has always been the

more outgoing and food motivated giraffe. However, our females, Tufani and Olivia were extremely skeptical and, on some occasions, took days or even weeks to interact with a novel item. However, eventually Tufani and Olivia observed Dave interacting with these novel items and followed suit. As they became braver and began interacting with new enrichment, their behavior shifted dramatically towards changes in their environment (Figure 11).

They became much more curious and eager to investigate new items as well as being less reactive to unfamiliar circumstances. All giraffe began shifting more reliably despite large crowds and sounds as well as becoming less reactive to changes in the barn. Throughout this journey, we have had to have quite a number of modifications and repairs to our barn and corral areas. Normally, this would have drastically affected our giraffe's behavior, but with this growing program, they took it in stride. Many of these modifications went unnoticed or were investigated briefly and forgotten quickly. Additionally, we had regrading done in our corrals, which required the use of heavy machinery. The process was very loud and disruptive, but the giraffe went about their day as if it were not happening at all. Even more surprising was that our male giraffe Dave appeared to be enjoying it. He chose to stand in the doorway of the barn and observe all the activity as it happened. We never expected the giraffe to shift back to the barn from savanna as a substrate compactor was operating as if it were not happening. Normalizing change for the giraffe has made them overall more resilient to events, construction, and new sights and sounds throughout the zoo.

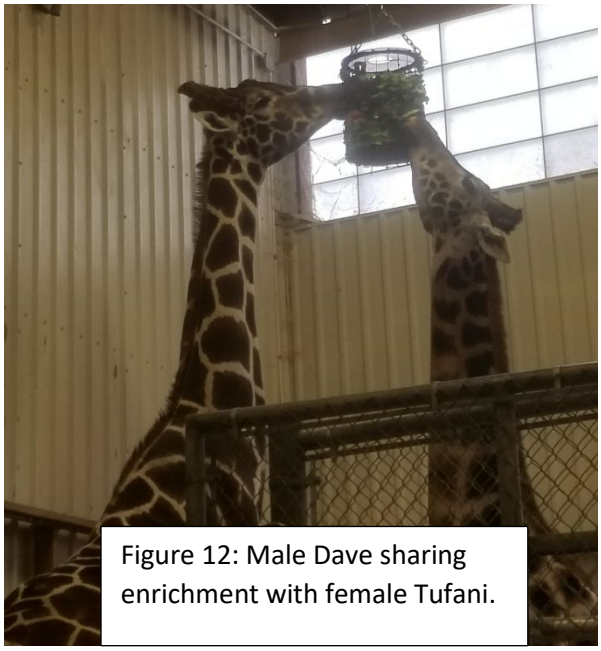


Figure 12: Male Dave sharing enrichment with female Tufani.

Another unexpected benefit we observed from this enrichment renovation program was our giraffe becoming a more cohesive tower. Before, our females were much more reactive to our male occupying the same space especially in the barn and corrals. They would retreat quickly and would typically avoid the areas our male frequented. However, as their confidence and curiosity about new enrichment grew, they would willingly share space with Dave and even share enrichment (Figure 12)! Dave, Olivia, and Tufani learned to coexist

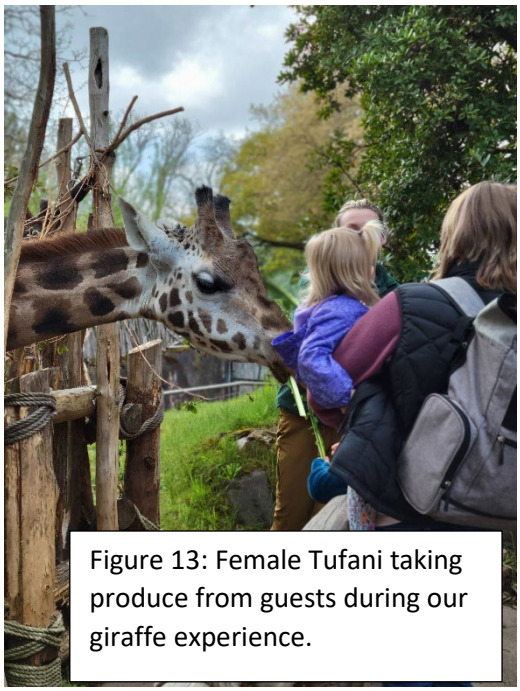


Figure 13: Female Tufani taking produce from guests during our giraffe experience.

and navigate in smaller spaces, which allowed them to have more time together in the colder months when they could not go out on savanna. Their ability to share enrichment and space more effectively made them more united and hardy.

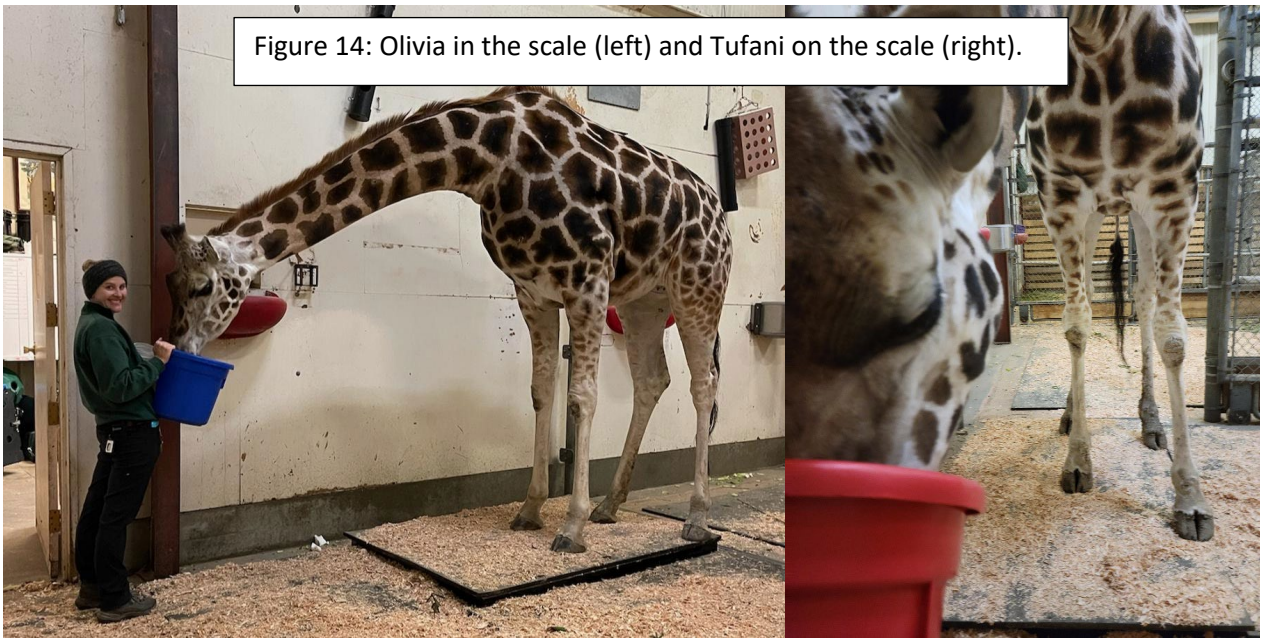


Figure 14: Olivia in the scale (left) and Tufani on the scale (right).

Finally, enrichments wins turned in to training wins. All three of our giraffe have made huge strides in their training since the enrichment program has expanded. Prior to the enrichment renovation, Olivia and Tufani would not take any food or reinforcement from the keepers. They would only eat what was offered in their diet bucket or in enrichment. They are now taking food and reinforcement not only from the keepers, but from guests as well (figure 13)! Moreover,

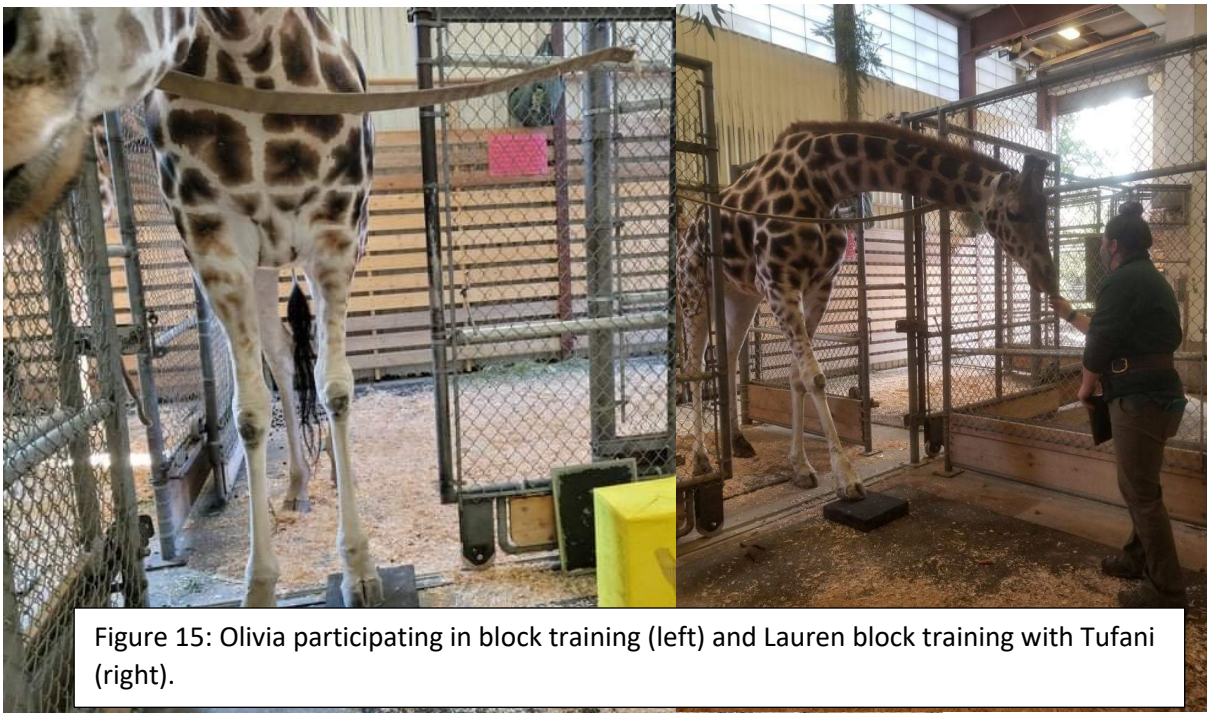


Figure 15: Olivia participating in block training (left) and Lauren block training with Tufani (right).

Olivia and Tufani have both gotten on the scale for the first time in several years (Figure 14) as well as placing their front hooves on blocks (Figure 15) and participating in touch training. Although Dave was further along on training, he too has made great strides in his learning curve. Since the program has evolved, he has participated in foot soak training (figure 16) as well as voluntary hoof x-rays on all four hooves. He has even mastered placing his back hooves on blocks.

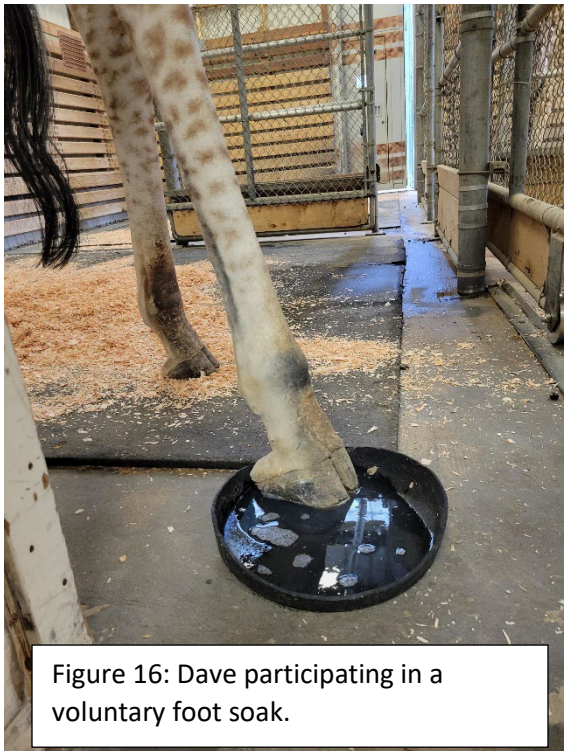


Figure 16: Dave participating in a voluntary foot soak.

Bright Horizons

In conclusion, this enrichment renovation project has benefited both keepers and giraffe in many more ways than were expected. Expanding the enrichment program and constantly adding new items to the giraffe's environment normalized change within their daily life. In turn, they became more resilient and confident in everything they did. Their willingness to interact with new and familiar items has directly translated in to great training progress. This program has improved the overall welfare and quality of life for our tower of giraffe. Seeing Dave, Olivia, and Tufani come out of their shells has been a beautiful byproduct that we will continue to expand on. We continue to develop and broaden our enrichment and training programs further that will soon carry over to the entire savanna collection.

“Working as One Group for Gorillas”

Connecting research to husbandry management for the best care of Cleveland Metroparks Zoo’s western lowland gorilla troop

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Abstract

In the zoo community, the words “research” and “husbandry management” typically get separated into two different categories. But what about when both things are occurring simultaneously for the same animal species in the same location? In the gorilla world at Cleveland Metroparks Zoo (CMZ), these two words aren’t placed in separate categories but rather fused together to provide the absolute highest welfare and care for our family group of western lowland gorillas. Over the years, CMZ’s Conservation and Science team has been looking at a variety of aspects of gorilla health, welfare, and management at the same time the animal keepers have been providing day-to-day husbandry care. This paper describes the merge and accomplishments of these two teams working together, overviewing what they have been able to achieve throughout the recent years. The main focus consists of the collaboration on saliva collection, urine collection, and behavioral monitoring and how this led to the big and small picture success of various husbandry decisions. Outcomes from these decisions ultimately increased the degree of care given to the gorillas on an individual and group level by meeting their needs medically, behaviorally and socially. This symbiotic relationship between research and husbandry has resulted in one of the most resourceful benefits for each team when combining their efforts for the same cause, the gorillas.

Introduction

Cleveland Metroparks Zoo (CMZ) currently houses a family group of western lowland gorillas made up of six individuals: a silverback, four adult females, and one male infant. When looking at the overall care of these animals, daily husbandry is the primary responsibility of the zookeepers but other individuals such as animal curators or members of the veterinarian team also have roles. CMZ is fortunate enough to have a Conservation and Science department (C&S) which is a team made up of animal welfare researchers, animal behaviorists, endocrinologists, a veterinary epidemiologist and individuals that specialize in population management. When the Animal Care and C&S teams come together to make overall management decisions as one group, the results have been outcomes with a high level of welfare. For the gorilla troop, saliva collection, urine collection, and behavioral monitoring were the primary areas over the last three years where success was evident in collaborations between departments.

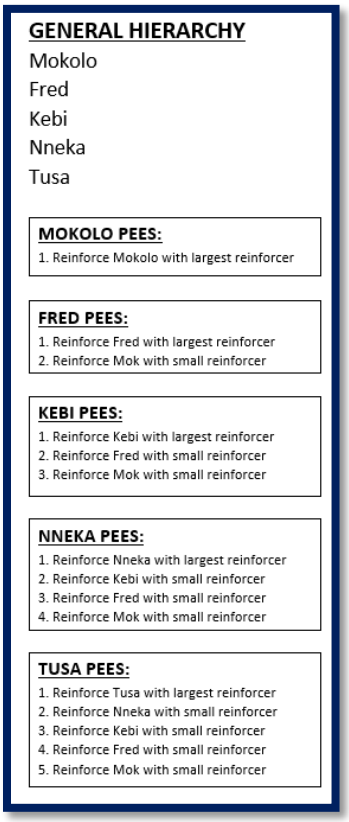
Saliva Collection

The C&S department has been interested in using saliva as a biological sample of choice to measure multiple hormones in CMZ's gorilla group including cortisol, oxytocin, and insulin. Zookeepers have previously trained the gorillas to either chew on a cotton swab (i.e. salivette) and trade it back or allow their lower gum line to be swabbed. The cotton swab full of saliva is then placed in a tube and frozen until the saliva is extracted and analyzed in the lab (Picture 1). CMZ's researchers are currently investigating potential associations between insulin resistance and regurgitation and reingestion (R/R) in gorillas. Beginning in January of 2020, C&S has conducted morning observation sessions on the gorillas to record all occurrences of R/R behavior. They sought to couple their observations with data on fasted salivary insulin levels for each individual to investigate potential relationships between R/R rates and insulin. In the future, there are plans for a multi-institutional assessment to look at insulin resistance in the North American gorilla population.

Picture 1:
Cotton swabs (salivettes) and collection

Urine Collection

Since most zoos do not readily train for collection of saliva samples from their gorillas, there was a need to assess insulin resistant biomarkers in urine, a more feasible and easily obtainable biosample. In order to make sure they were accurately measuring biomarkers of insulin resistance in the gorilla saliva and urine samples, it was necessary to perform an oral sugar test. For this, samples of saliva and urine needed collected at specified timed intervals before and after the gorillas were fed a high sugar item. This led to zookeepers and C&S working together to train the gorillas for voluntary urination. Zookeepers wrote up the training plan as well as a hierarchy reinforcement delivery cheat sheet (Picture 2) and worked through communication on approximations as C&S would come in the morning three times a week for about an hour to start the capturing and shaping process. C&S's involvement was critical in this part of the training, since first thing in the morning is when keepers have their heaviest workload and didn't have the time it could take for the initial capturing. During this stage, keepers separated the gorillas and gave diluted juice first thing in the morning, C&S worked on the initial capturing of urination and noted times between juice consumption and urination. This eventually transitioned to putting the behavior on cue. It was already helpful that the researchers had spent



Picture 2: Hierarchy reinforcement sheet for urine training

hours of time with the gorillas over previous years doing observations because the gorillas were familiar with them being in holding. This provided confidence in the fact that C&S staff would be the ones to deliver food reinforcement to the gorillas. During the middle of the process, once capturing turned into shaping, a way to easily collect the urine was needed. For this, staff came up with the invention of the "gorilla potty" which essentially is an upside down milk crate with a funnel system attached to it. Staff could then cue the gorilla to sit on it and then ask them to pee. The urine then funneled through a tube into a collection area in the keeper space. (Pictures 3-5)

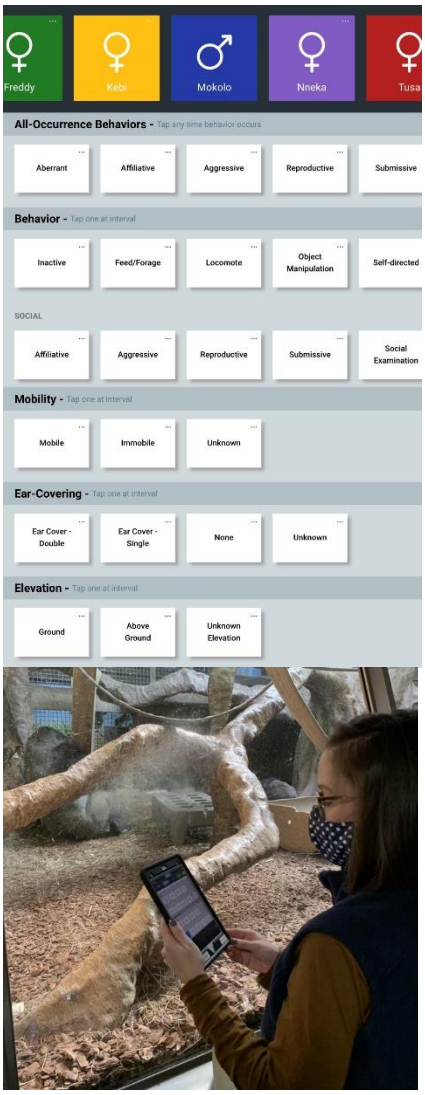


Pictures 3-5:
Gorilla potty for urine training and collection

The behavior took about six months to truly establish, keeping in mind that there is only opportunity for one shaping approximation each session due to the biological nature of an individual having to pee only so often. Not only was this behavior furthering research but it is also beneficial for husbandry management since urine samples would have to be collected quarterly for routine pregnancy checks as protocol for all the great apes housed at the zoo. What used to take a good bit of time and monitoring from keeper staff to collect a sample, now can be asked for on cue.

Oral Glucose Test

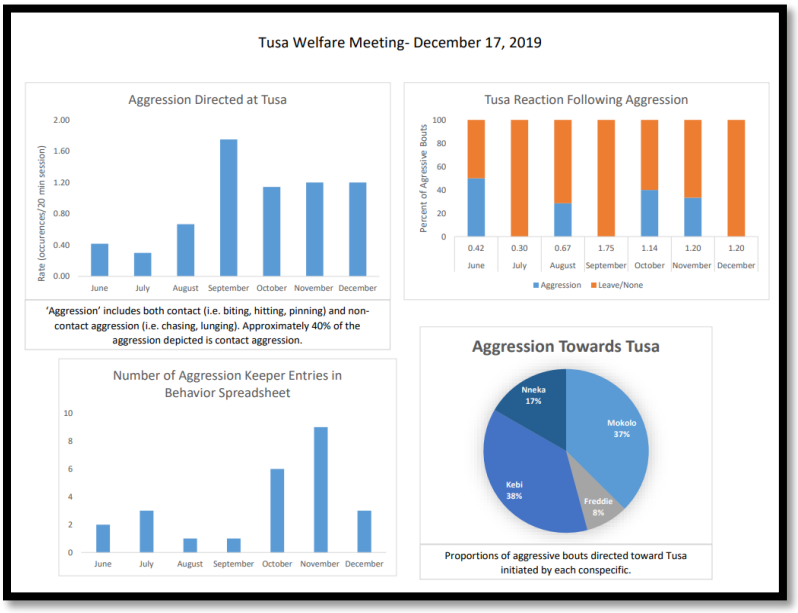
Once urine was able to be collected on cue, an oral sugar test could be conducted. This assessment is similar to a glucose tolerance test in humans, and would help validate the measurement of insulin resistance biomarkers in the gorillas. For this test, timed urine and saliva samples were collected from the gorillas before and after they ingested a sugary meal, and the researchers were then able to visualize the gorillas' insulin response. In June of 2021, CMZ staff was able to successfully collect a total of 35 saliva samples and 26 urine samples from the five adult gorillas throughout the course of the day. Fasted saliva and fasted urine samples were first collected from each gorilla, then they were each fed a predetermined and weight-controlled amount of sugar. After this, saliva samples were collected without additional reinforcement at 30 minutes/60 minutes/90 minutes/120 minutes post consumption. Additional urine samples were collected after the 120 minute saliva sample, and final urine samples were collected at least two hours later. CMZ is the first to systematically conduct an oral sugar test on gorillas.
Results from this study has also had a beneficial husbandry impact on the gorillas. The results indicated that one female's salivary insulin was quite elevated, which would have not normally been detected in her routine exams. She has since been placed on medication and C&S continues to monitor her as changes in her medications are made. Having these behaviors in place just gives additional valuable tools to monitor her values, providing the best care in this situation from a medical perspective.



Pictures 6-7:
ZooMonitor gorilla data collection interface (top) and Data collection in ZooMonitor (bottom)

Behavioral Monitoring

C&S uses a data collection program called "ZooMonitor." It essentially is an online application developed by Lincoln Park Zoo to record and visualize animal behavior data. (Pictures 6-7). For CMZ's gorilla troop, data are collected on solitary behaviors, social behaviors, overall activity level, elevation within habitats, and proximity of individuals. This long-term behavior monitoring started in August of 2017 and we currently have over seven hundred hours of data on the gorilla troop. This has been an invaluable resource for the keeper staff during two main times within the last three years. The first was getting the newest adult female, "Tusa," integrated into the group during 2019 to 2020. Tusa came to CMZ in May of 2019 and keepers started to see the number of altercations increase from June through the end of that year. At this point in time, CMZ pulled data from the ZooMonitor program to compare aggression toward Tusa over time (Picture 8). This data suggested aggression rates towards Tusa were increasing.

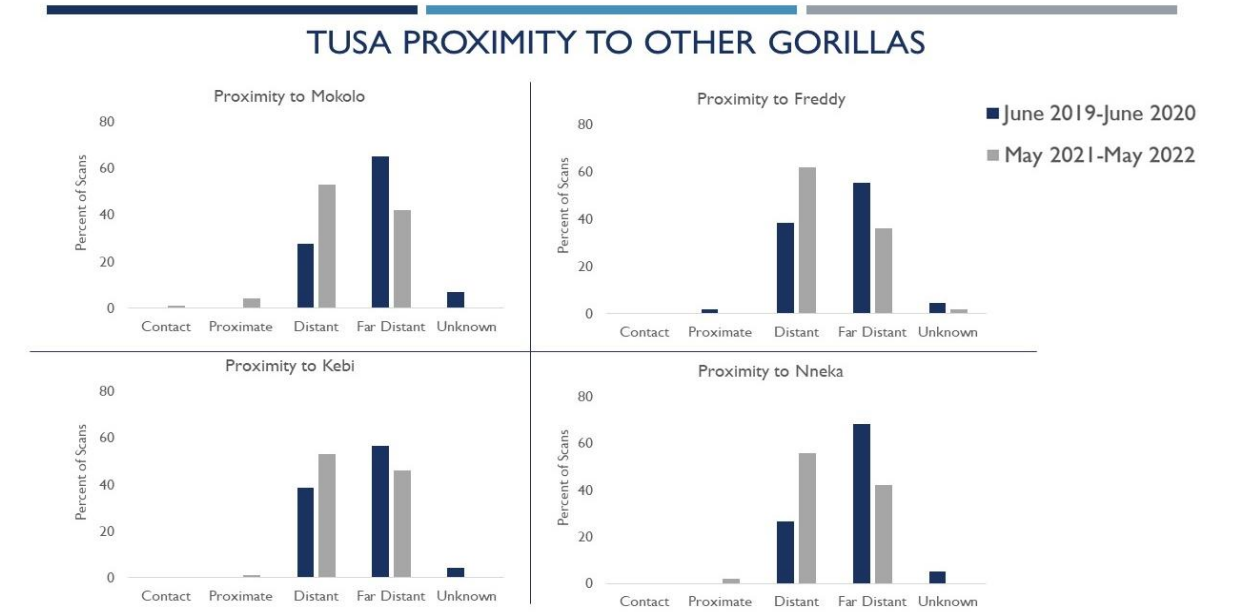


Picture 8: Graphical representation of Tusa data from ZooMonitor

Tusa was also decreasing in weight during this time period, so the team had a welfare meeting in December of 2019, followed by a GBAG (Gorilla Behavior Advisory Group) consultation in January of 2020. After these meetings, husbandry modifications were made while C&S continued to collect data, providing means to evaluate any negative or positive changes of overall behavior during the modifications. Keepers implemented hierarchy reinforcement, removal of communal high value items, morning routine separations, and routine randomness. Such changes continued throughout the months of January and February. In March, April, and May altercations and aggression decreased a considerable amount to a more normal level for gorilla troop interactions. This decrease was tracked by overall number of altercations, Tusa's proximity to other

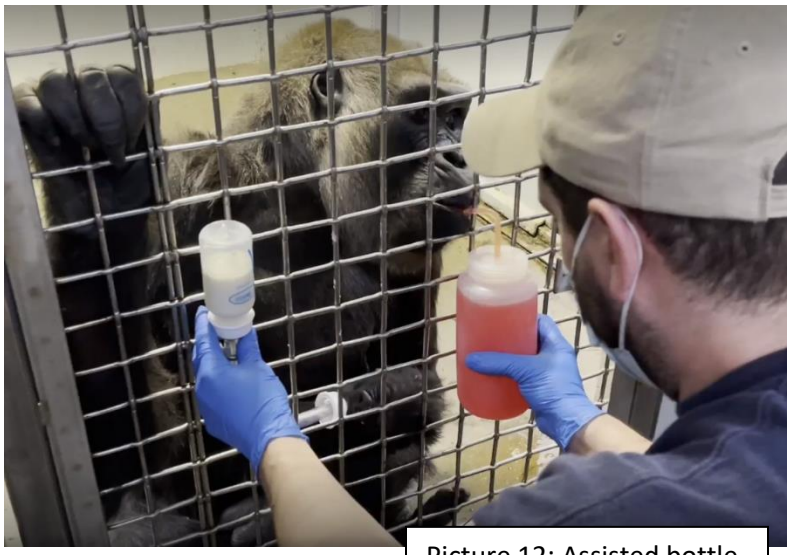
gorillas (Pictures 9-11), documented levels of wounds, and comparisons between data before and data after husbandry modifications where improvements are visually noticeable. Having this invaluable information resulted in improved welfare for the overall group as well as Tusa's individual welfare. CMZ staff was able to decrease overall number of altercations and begin to observe consistent breeding. Additionally, Tusa's weight increased into her target range due to communal feeding strategies. With these beneficial changes, the gorilla group was now considered stable.

Pictures 9-11: Graphical and pictorial evidence of Tusa's proximity to other gorillas improving



Having a stable, cohesive group meant that CMZ management could move forward with a breeding recommendation from the Gorilla Species Survival Plan (SSP®), which leads to the second time behavioral monitoring has been able to aide keepers in their husbandry decisions. In April of 2021, one of the group's females, "Nneka," became pregnant. The birth window was estimated to be late December to

January; however, she gave birth in October to a male infant, "Kayembe." Knowing when Nneka was expected to give birth, keepers were confident he arrived at least six weeks premature. After she gave birth, Nneka did not pick up or show a significant amount of interest in Kayembe. Thankfully, previous maternal, paternal, and foster training was done with all the gorillas in the group. So when mom decided she wasn't interested, "Fredrika," a different female in the group showed excellent maternal care by picking Kayembe up within two minutes of being introduced to him. As keepers were busy implementing training for assisted bottle feeds (Picture 12) and group stationing, C&S was able to jump in and cover monitoring for the first seventy-two hours. This made sure no other health or behavior concerns were missed. They also gave keepers full reports from their observations. When the seventy-two hour window was cleared, C&S went back to their normally scheduled gorilla data collection routine.



Picture 12: Assisted bottle feeding of Kayembe

Everything was going smoothly up until November 12 when Kayembe fell ill with pneumonia. At this time, human assisted rearing was implemented until his estimated to-term window in later December. This assistance gave him time to resolve the reflux apnea, which may have been associated with his premature birth, and ultimately lower the chance of pneumonia reoccurring. On December 29, Kayembe was introduced back to the gorilla group and Fredrika went right back to providing full time care to him, including bringing him up for his scheduled bottle feeds. It was then observed over the first several days that Kayembe's formula intake had decreased from approximately an 18% body weight consumption to about 12.5%. This was puzzling as keepers hadn't confidently noticed any behavioral changes in the group or him, but had no true way of gauging weight or documented behavior data.

So it was C&S to the rescue again when they jumped in and started continuous behavior data collection sessions on Kayembe. This information was then readily accessible and utilized to make informed decisions on what the best course of action should be (Picture 13).

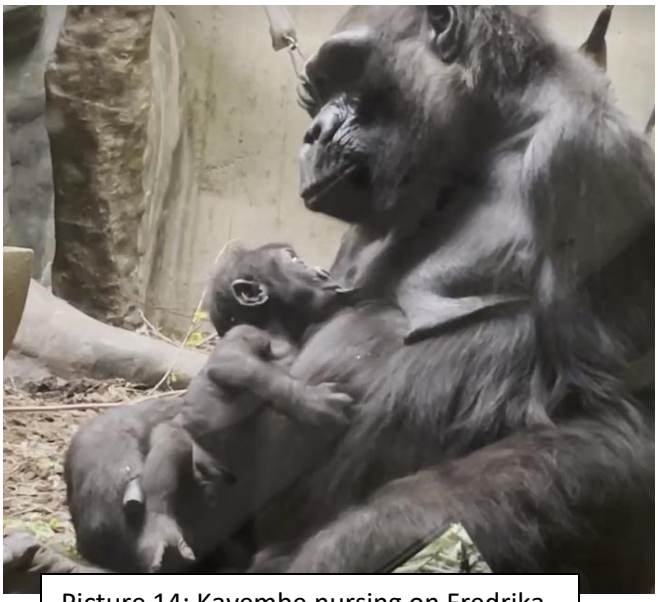
Infant Gorilla Behavior Monitoring – 28 Feb 2022

INFANT GORILLA BEHAVIOR MONITORING PROTOCOL

ETHOGRAM:

INFANT CONTINUOUS BEHAVIOR (recorded as durations)	
Solitary Behavior	**Definition**
Not Visible	Infant's behavior is not visible
Rest	Infant is immobile with eyes closes. Likely sleeping.
Alert	Infant is immobile with eyes open and *alert*. Head is supported by another gorilla or a substrate.
Active 1: Head up or moving	Infant is immobile with eyes open and alert. Head is lifted and unsupported by another gorilla or substrate.
Active 2: Limbs moving	Infant is immobile and actively moving arms or legs. Head may be unsupported or supported. Includes examination of solid food or objects with hands or feet.
Active 3: Weight-bearing no Movement	Infant is immobile but actively pressing arms or legs as if to lift the body without moving body's location. Precursor to crawling. Also includes when infant is supporting his own body weight while adult gorilla is locomoting (i.e., on the adult gorilla's arm)
Active 4: Weight-bearing with Movement	Infant is using limbs to push up and move his center body mass to a new location by rocking, scooting, crawling, etc Less than one body's length
Mobile	Infant is using limbs to push up and move his center body mass to a new location by rocking, scooting, crawling, etc More than one body's length
Rooting	Infant is actively searching for nipple by moving head from side to side in the vicinity of Fredrika's chest
Suckling	Infant is latched onto Fredrika's nipple and sucking

Picture 13: The ethogram, or list of interested behaviors, used during Kayembe's behavioral monitoring.



Picture 14: Kayembe nursing on Fredrika

While C&S conducted these sessions, suckling from Kayembe was observed on Fredrika (Picture 14). This had also been observed prior to him falling ill and needing human assisted rearing; however, the continuous data recording session were able to note potential swallowing and increased number of bouts. Shockingly, on January 8, keepers noticed white droplets from one of Fredrika's nipples. Keepers did training throughout the day and were able to confirm that Fredrika was indeed producing breast milk as she allowed keepers to perform hand milking. A sample was collected and sent to a lab which confirmed the substance was nutritious milk content (Picture 15).

Picture 15: Hand milking Fredrika

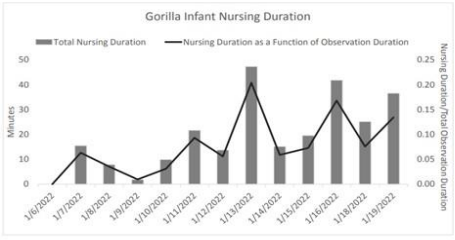
C&S continued their behavior monitoring with the addition of recording nursing bouts, allowing new information that could be looked at in relation to his formula consumption. Nursing information was also extremely beneficial moving forward, aiding keepers in making husbandry decisions like when to offer or not offer bottles to encourage nursing as much as possible (Picture 16).

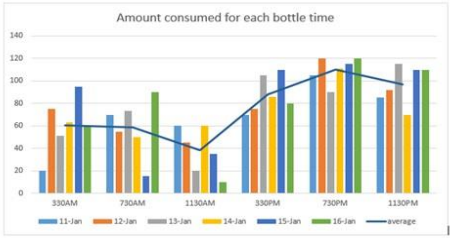
Picture 16: Kayembe's daily and hourly nursing and bottle consumption data.

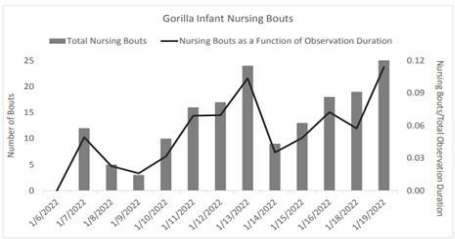
Nursing Data

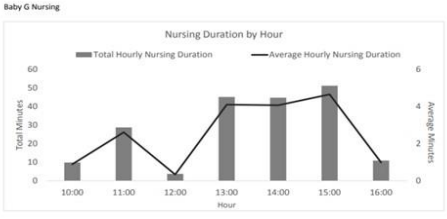
Individual Nursing Bout Length

Time	Side	Minutes
11:02:14	Suckling Left	1.38
11:05:35	Suckling Right	0.98
11:10:32	Suckling Right	0.65
11:13:29	Suckling Right	0.85
11:20:04	Suckling Left	3.75
13:27:45	Suckling Left	2.72
13:31:17	Suckling Left	2.18
13:33:39	Suckling Left	0.53
13:34:39	Suckling Left	3.02
13:56:17	Suckling Left	2.88
14:00:40	Suckling Left	1.02
14:02:33	Suckling Right	0.68
14:03:19	Suckling Right	4.58
14:14:30	Suckling Left	2.78
14:24:05	Suckling Left	0.53
14:26:52	Suckling Left	0.37
14:28:11	Suckling Right	1.35
14:29:35	Suckling Right	2.47
14:32:15	Suckling Left	0.45
14:33:42	Suckling Left	0.03
14:37:16	Suckling Right	2.05
14:39:35	Suckling Right	0.88
14:43:35	Suckling Left	4.73
15:03:11	Suckling Right	6.35









The concentrated amount of infant behavioral monitoring continued through February and March. Then throughout April, C&S decreased the amount of observation time and changed the behaviors of interest based on Kayembe's development. In late April, keepers were able to get a weights on him (Picture 17), and at that time, it was decided that systematic behavior collection on him was no longer needed, so C&S returned to their regularly scheduled group monitoring.

Picture 17: Kayembe on scale

Overall, this journey of Kayembe's initial start to life might have looked very different without C&S being able to provide so much behavioral data to help the CMZ staff. Information from these data allowed the best decisions for him to be made despite the challenges of not knowing a weight or how much he was getting to eat. Otherwise, it might have been necessary to pull Kayembe from the group and continue human-assisted rearing which would not have given him the chance to thrive with his gorilla group. Working together to combine behavior and nursing data with formula consumption information until weights could be obtained kept him with the gorillas and provided the best path for Kayembe and the troop as a whole (Picture 18).

Picture 18: Kayembe thriving with the group

Conclusion

At Cleveland Metroparks Zoo, it is without any doubt that top notch welfare for our gorilla group lies within the collaboration between the animal care and C&S departments. Only when working together as one group can the most informed decisions be implemented. These decisions have been the best course of action because they are backed up by valuable research and data collected directly from the gorillas. Through these examples from just the last few years, it is clear that this is the most productive path moving forward. It will be exciting to see what the future holds not only for the gorilla group housed in Cleveland but the collective managed population as a whole.

Pictured Left to Right:
Laura Klutts - Gorilla Keeper
Brian Price – Gorilla Keeper
Dr. Pam Dennis - Veterinary Epidemiologist
Kaylin Tennant - Graduate Research Associate

AAZK's International Outreach Committee

Yvette Kemp, Chair
International Outreach Committee
American Association of Zoo Keepers

Abstract: The American Association of Zoo Keepers (AAZK) International Outreach Committee (IOC) was established to provide training, resources, and opportunities for international animal care professionals to better provide for the animals within their care. With a current focus in Latin America, the IOC's goals of improving and increasing resources and training to international animal care professionals is an on-going process involving several initiatives. These initiatives provide expanded access to the AAZK's resources through translated materials, a travel grant program, reduced membership costs, and a member sponsorship program. The headlining program the IOC has developed is a Capacity Building Program that is available to Latin American animal care professionals several times per year. These professional development programs are hosted at different zoological institutions across Mexico and are designed as mini conferences with the goal to expand to other Latin American countries. Subject matter specialists from the United States travel to these programs to provide lectures and hands-on workshops regarding a variety of zoo-related topics. The programs also provide an opportunity for Latin American animal care professionals to participate as speakers and workshop leaders. These Capacity Building Programs have reached over 600 participants.

The IOC hopes to continue this valuable work within Latin America with the development of new programs and expanded opportunities for animal care professionals. With the amount of on-going programming the IOC offers throughout Latin America, there are opportunities for U.S. animal care professionals and AAZK members (especially Spanish speakers) to participate in a variety of ways.

Introduction

The American Association of Zoo Keepers has decades worth of experience across every taxa managed in American zoos, with countless individuals working tirelessly to improve the welfare of animals under their care. These zoo and animal professionals are passionate about their careers and their responsibilities and AAZK provides a national platform where this wealth of information can be discussed and shared. The International Outreach Committee (IOC) was established in 2016 by the American Association of Zoo Keepers (AAZK) with the primary purpose of exploring and identifying the professional development needs of the international animal care community and to provide educational and mentorship resources that support advances in the field of animal husbandry. The IOC has been able to expand the vast knowledge and skills of AAZK's membership and resources across international borders through the committee's current programming and future goals.

Mission and Goals

The International Outreach Committee's mission is to provide resources, training opportunities, and continuing education in the Latin American zoological community through AAZK professional development material, AAZK Committee Programs, AAZK National Conferences, and to support worthwhile international programs focused on advancing the animal care profession. During the early formation of the committee, groundwork was laid to establish the following main goals of the committee:

1. Develop a professional relationship with Latin American zoos, aquariums, animal care facilities, and professional associations.
2. Provide assistance and guidance to increase professional development opportunities for animal care staff.

A robust plan was developed to address the mission and goals established by the committee. Throughout the years, the following projects were initiated by committee members and each has expanded to become what is offered today:

1. Latin America Travel Grant (LATG) to AAZK National Conference
2. Emerging Nations Member Sponsorship and Developing Nations membership
3. Capacity Building Program for Latin American animal care professionals
4. Translation of AAZK material and resources into Spanish

Latin America Travel Grant

The establishment of the Latin America Travel Grant (LATG) provides the necessary funds to allow animal care professionals from Latin American zoos to travel to the annual AAZK National Conference. This grant amount is valued at up to $3,000 and helps the recipient or recipients cover the costs of travel, lodging, and other necessities of attendance that otherwise would prevent Latin American keepers from attending. Securing funding through AAZK National was only the first step of many that would see this grant opportunity realized.

Once the funding was secured, a system for the application, evaluation, notification, and disbursement of funds needed to be developed. The application process involves applicants submitting the necessary application materials to the IOC instead of the normal avenue of submission directly to the AAZK Grants Committee. This was due to the need for translation of the application materials into English since the application itself is available in Spanish and the majority of applicants will submit their application in Spanish. Once received by the committee,

the application material is translated to English and provided to the AAZK Grants Committee for scoring along with ratings for each applicant. Once the Grants Committee scores and ranks the applicants, a recipient is selected and ratified by the AAZK Board of Directors. Winners are notified by the IOC in Spanish and a committee representative begins to assist the recipient with the next steps of planning their attendance to the conference.

The final aspect of the grant program that involved many discussions and trials to approve was an effective and efficient method to distribute the funds to the recipient. Not only were funds required to be distributed in the recipient's currency, but AAZK National was also faced with distributing funds in another country. One stumbling block to overcome was developing a way to provide the funds to the recipient before travel and hotel accommodations could be booked. Many Latin American animal care professionals live on small salaries and are challenged with paying for an international plane ticket on their own without the grant funds. With collaboration from IOC committee members and AAZK National, a system has been developed where a portion of the grant funds are distributed to the recipient after the award announcement to aid in conference registration and booking travel and hotel accommodations. This system has been proven to be effective at meeting the needs of the grant recipients.

So far, the Latin American Travel Grant Program has provided opportunities to fifteen (15) Latin American keepers to attend the AAZK National Conference. One recipient attended the conference hosted by the National Chapter of the American Association of Zoo Keepers in Washington, D.C., and two recipients attended the 2019 National Conference hosted by the Indianapolis Chapter of the American Association of Zoo Keepers in Indianapolis, Indiana. Unfortunately, as we know, the 2020 AAZK National Conference was cancelled but it provided a unique grant opportunity for the hybrid 2021 conference hosted by the Los Angeles AAZK chapter. Since the 2021 conference was hybrid and there were still many travel restrictions for international travelers, AAZK and the IOC were able to provide twelve (12), yes 12, virtual registration packets to animal care professionals from Mexico, Argentina, Colombia, Guatemala, and Peru! Additionally, we are excited to have another LATG recipient joining us for the 2022 AAZK National Conference in Toronto, Canada.

AAZK Emerging Nations Member Program

The IOC AAZK Emerging Nations Member Program was designed to connect AAZK chapters with international keepers to provide sponsored AAZK professional memberships for international animal care professionals. IOC's Membership Team recruits interested AAZK chapters to sponsor a one-year professional AAZK membership for Latin American animal care professionals. These chapters are then matched with a Latin American animal care professional that is identified from a list of interested individuals that have been recruited from IOC Capacity Building Program participants, connections through Latin American zoological associations, or

other related paths. Once Latin American keepers are matched with a sponsoring chapter, the IOC Sponsorship Team aids in communication between chapters and their sponsored international keepers.

AAZK member sponsorships can provide additional resources to Latin American animal care professionals that may not otherwise be available. Even though the cost of an annual membership is within the budget of most American animal care professionals, that is not always true with their Latin American counterparts. Not only are the resources of a paid membership highly beneficial, but the sponsored keepers can also feel connected to a larger network of other animal care professionals.

AAZK has provided more opportunities for interested Latin American keepers by reducing the cost of international membership for those animal care professionals living in Latin American countries. The new Emerging Nations membership cost has been reduced from the $55 annual cost for international members to a $10 annual membership for those animal care professionals located in 22 countries including Mexico, Argentina, and Costa Rica. By providing a membership cost that is more in line with the actual earnings of animal care professionals in other countries, AAZK has opened the door to resources and a network designed to continually improve animal care.

The Emerging Nations memberships provide Latin American keepers with an annual membership that include all benefits provided to AAZK professional members, with access to the Members-Only section of the AAZK website, an electronic copy of the Animal Keeper's Forum, discounts on conference registrations, and inclusion in an ever-growing animal care community. Thanks to the Emerging Nations membership and sponsorship program, AAZK chapters and the IOC have provided AAZK Professional membership to over 80 Latin American animal care professionals!

AAZK IOC Capacity Building Program

The Capacity Building Program (CBP) was developed to provide training for animal care professionals in Latin America and consists of mini-conferences and workshops led by IOC and AAZK members. Many Latin American keepers have not received any kind of formal animal care training and in some cases, any sort of formal education or animal care training, as there are no current programs designed for zoo keepers. The Capacity Building Program has been able to fulfill that much needed niche.

The CBP not only provides a means for training keepers, but it has also become a platform for Latin American keepers to share their knowledge and open communication lines amongst keepers in the field. These keeper-based programs have given the attendees a chance to network and develop connections that will help them grow professionally and learn how to become active members at their organizations and within the animal care community, something that is normally restricted to veterinarians and zoo directors.

The IOC has organized seven Capacity Building Programs in different parts of Mexico and has worked with over 600 participants during those programs. The program features IOC and AAZK members, along with keepers from other U.S. institutions, sharing information through oral presentations and workshops in these mini-conference settings. The beauty of the program is that Latin American keepers are also encouraged to present posters and oral presentations, thus developing a culture of professionalism and communication, something that has not been traditionally available to animal care professionals under the managerial level. The Capacity Building Program aims to not be a one-way stream of information. As we know from working in the animal care field, there is not one way of doing something, yet we all have the same goals. Being able to learn about animal care from our Latin American colleagues has been educational and inspiring as well.

To say that the program has been amazing not only for attendees but also for committee members and other instructors that have participated, is an understatement. The ability to share information that will not only help improve the care of animals in facilities throughout Latin America, but also help an animal care provider grow professionally is a feeling that is hard to describe.

Our last formal program took place in October of 2019, right before the pandemic hit. 2020 programs were cancelled and thoughts of being able to reconnect with our Latin American colleagues seemed to disappear. But just like everyone else, the IOC adapted! In May of 2020, the IOC changed its Capacity Building Program style to Zoom presentations and gatherings. Since then, we have hosted 26 Zoom presentations and round tables, ensuring that we keep in touch with our Latin American colleagues (Figure 1: examples of Zoom presentation flyers).

Figure 1. IOC Zoom presentation flyers: adapting to new methods, ensuring continued connections with our Latin American colleagues.

Not only did we change our format to Zoom, but we have also been working on providing more opportunities to those who would like to join us when we are able to resume the Capacity Building Programs in person. One of these opportunities is a scholarship that covers the registration costs for 2 program attendees. Registration for the programs is $78, which includes entry to all presentations and workshops, meals and snacks during the 3- or 4-day program, transportation, and any other activities that are offered. Covering the registration helps reduce the total cost of the program for the attendee, who will need to potentially cover the hotel, travel, and loss of wages, which are rarely if ever covered by their institution.

The IOC has also partnered with AZCARM (Asociación de Zoológicos, Criaderos, y Acuarios de México), the "AZA of Mexico," to provide additional scholarships during Capacity Building Programs that are organized in conjunction with AZCARM's annual conferences. The IOC and AZCARM work together to develop the AZCARM scholarship, which includes registration and hotel stay, and to select the scholarship recipient.

Our hope is to continue offering Capacity Building Programs throughout the year once it is safe to meet in person again. We have already informed AZCARM that we are ready to start up and we look forward to providing professional development opportunities with input from both North and Latin American animal care professionals.

AAZK IOC's Capacity Building Programs provide an opportunity for all of us to fulfill our mission and vision as active AAZK members: to advance excellence in the animal keeping profession, to foster effective communication beneficial to animal care as well as professional development and personnel connections that advance animal care.

Translations

The International Outreach Committee also focuses its efforts on translating materials from English into Spanish and vice versa to increase the availability of materials to Latin American animal care professionals. AAZK teaching materials, including webinars, courses, proceedings, presentations, and more are collected and translated from English into Spanish. Materials from the AAZK Annual Conference are translated as well and sent to the Latin American Travel Grant recipients to assist them in planning and preparation for the conference. Materials may be translated in partnership with other organizations, including ALPZA (Asociación Latinoamericano de Parques, Zoológicos y Acuarios), AZCARM (the "AZAs" of Latin America and Mexico), to further communication and the exchange of resources between all organizations.

AAZK materials are translated in order based on priority according to interest by Latin American keepers. The IOC Translation Team, which includes Spanish speakers on the committee, divide translations projects and work individually before exchanging translations with each other to proofread and edit. Materials are then passed on directly to the requesting entity or stored in the IOC's resource library. The translations can be used later to further the exchange of materials with other zoo keepers.

The IOC also works with several of the AAZK Committees and Programs to translate communications and information that is beneficial to the Latin American members. Social media

posts (Figure 2: social media post), e-Blasts, member emails, and even a few AKF articles are provided in Spanish for our ever-growing Latin American membership.

Figure 2. Bilingual AAZK post on Facebook www.facebook/americanassociationofzookeepers.com

IOC Committee Program Opportunities

Even though the IOC was just developed in 2016, we believe that through the efforts of AAZK, its members and chapters, and a very committed IOC committee, we have been able to quickly grow and develop programs that we had envisioned, plus much more. Due to the rapid growth of the committee and the number of projects we plan to offer, the IOC recently decided to regroup and restructure to ensure that we continue to offer our current programs and are able to develop new ones.

The new restructured IOC now consists of 7 different teams that assist with ensuring information is maintained and plans are created for our various programs. The new IOC teams include the Latin American Membership, Professional Development, Translation, Resources,

Communication, Recognition, and Projects Teams. As pandemic restrictions are reduced, more opportunities to help our Latin American colleagues will arise and the IOC wants to ensure that we are able to support them and offer up to date resources relevant to animal husbandry. The IOC will need the assistance of AAZK members to continue growing.

Conclusion

The International Outreach Committee has implemented a variety of programs and resources to better serve animal care professionals abroad and connect them with the professional membership of the American Association of Zoo Keepers. The IOC hopes to continue this valuable work within Latin America with the development of new programs and expanded opportunities for animal care professionals. With the amount of on-going programming that the IOC offers throughout Latin America, there are opportunities for U.S. animal care professionals and AAZK members (especially Spanish speakers) to participate in a variety of ways. Join our diverse and dynamic group of animal care professionals who want to make a difference in zoos around the world. See how you can make an impact while meeting new people and networking internationally. Interested individuals can contact the committee at ioc@aazk.org to learn how they can assist.

For Flock's Sake:
Creating a Plan for Poor Feather Conditions in a Lorikeet Flock

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Denver Zoo's Lorikeet Adventure exhibit is an outdoor, mesh covered, walk through aviary that houses up to 60 lorikeets. Rainbow Lorikeets (Trichoglossus moluccanus) and Coconut lorikeets(Trichoglossus haemotodus) have always been the core species, with several additional lory and lorikeet species throughout the years. The exhibit is open for guests to walk through, with the option to purchase nectar to feed the lorikeets. Since the exhibit opened in 2006 there have been several individuals that have shown feather plucking to various degrees. After keepers watched one bird develop a plucking habit, becoming bald on his entire torso within 2 months, they realized they needed to be able to monitor feather issues more closely and act quickly.

As part of Denver Zoo's Welfare Program, all animals receive quarterly welfare assessments that score individuals or groups on 9 standardized indicators (or outcomes). One of these indicators is "Condition of Scales, Skin, Nails, Hooves, feathers, etc", which is how feather condition would be scored. In addition, a monthly feather condition rating for the entire flock began in 2018. Each bird is rated from 0 (perfect) to 4 (bald spots) for various parts of the body, giving more detailed information. With these tools already in place, it was decided that birds with feather problems would also be started on a Chronic Condition (CC) Assessment. These assessments are for animals with known conditions that should be monitored more closely, must be done at least monthly, and aid in determining long-term trends that demonstrate improvement, slow decline, or no change.

In July 2020, the Lorikeet Poor Feather Condition Plan began. Any bird with a noted feather issue is photographed every 2 weeks, compared to previous photos and rated "better", "same", or "worse" in a CC assessment. Based on these ratings, birds are put onto five possible paths: Active, Declining, Improving, Stable, and Resolved. Different actions go along with each path, and birds can be triggered to move between paths based on their CC ratings (see figure 1). Keepers also do a monthly Environmental Condition Assessment of any birds on the plan to keep track of changes to their environment.

Figure 1:

Path:	Description / Triggers:	CC Assessment Frequency:	Actions:
Active:	Any new or continuing feather condition	2 weeks	• Begin Chronic C ondition (CC) Assessments • Begin Monthly Environmental Condition (EC) Assessments
Declining:	Any of the following apply: • A bird has had 2 "worse" ratings in a row • Condition is worsening drastically • No improvement or change within 3 months	2 weeks	Active actions plus: • Managers notified • Vet exam scheduled • Behavioral husbandry consultation • Welfare Action Plan created
Improving:	A bird has had 2 "better" ratings in a row	Monthly	Active actions except: • Move to monthly CC assessments
Stable:	• Bird has been through all steps of the plan • Bird has a consistent feather condition • Bird is stable medically and behaviorally	Monthly	Active actions except: • Move to monthly CC assessments • Move to quarterly EC assessments
Resolved:	Feather problem is no longer apparent	None	Discontinue CC & EC assessments

Staff look at both medical and behavioral aspects as potential causes for feather plucking. A monthly meeting involves: Lorikeet keepers, Bird Department managers, Welfare Director,

Behavioral Husbandry Manager, Veterinarians, and Nutritionist to discuss any Welfare Action Plan items, medical updates, new cases, individual path changes, and brainstorming.

Since the plan started, there have been 19 individuals on the plan, with 24 total "cases", 9 of which were resolved. A few birds' cases have resolved, only to return to the plan months later. While the exact cause of feather plucking is often hard to pin down, looking closely at these birds physically and behaviorally has benefited their overall welfare.

There are 4 cases where feather loss may have been linked to pain or illness. Most of these are older birds who were also showing some mobility issues and were found to likely have arthritis. These birds are now on pain medication and closely monitored. One bird was found to have lymphocytic leukemia during her exam. Since it was discovered early and she was not showing other signs of illness, staff were able to treat her with oral chemotherapy and she lived comfortably for over a year. There has also been some speculation of hypothyroidism in a few cases, but veterinary staff are still working to determine better testing and information for this.

Many birds on the plan appear healthy after their exam, so are more likely to have a behavioral or social cause to feather plucking. Keepers began examining the lorikeets' daily care to look for areas to improve appropriate behaviors. The exhibit offers many options for the birds: room to spread out and have their own territories; sun, shade and mist; ability to be around guests or out of sight; and foraging opportunities through guest feeding. It has many naturally enriching elements such as live plants for perching, climbing and chewing, dirt to dig in, ground plants to bathe in, and plenty of space for flight. The holding area is less dynamic, with smaller, separate spaces and little to no visual barriers. Since birds are in the holding area more often in the winter, this became a focus. Keepers not only increased the amount and frequency of enrichment given daily, but worked towards different behavior goals, especially shredding, foraging, and hiding. Since chewing and shredding behaviors can directly relate to feather plucking, keepers make sure to have at least one type of shredding item daily. Lorikeets also naturally spend much of their day foraging. Lixits, slow feeder bowls, and movable hanging baskets and bins have all helped change up nectar feeding inside, while various forms of skewers and puzzle feeders are used for fruit and vegetable diets. Since the inside holding is all mesh caging, there are not a lot of natural hiding spots for the lorikeets. While the mesh walls between enclosures provides a physical barrier, birds were constantly surrounded by each other visually. Keepers installed twin wall panels in a few places to create visual breaks, and created hide boxes to give a bird the option to surround itself on 3 sides. Keepers also began moving around "furniture": enrichment bins, food platforms, and hide boxes were put on hooks for easy movement, and eyebolts were attached to perches to make them easy to move. All of these items can now be rotated around easily.

As keepers were examining the birds' routines, some easy management changes were made to give the birds more choice in their daily lives. Keepers began leaving access to indoor holding during the day, allowing birds the choice of where to be. This has proven to be desirable to a few birds on occasion, but overall, the flock chooses to be on exhibit and there is not a noticeable difference to guests. On borderline weather days, a couple of the least feathered birds choose to be inside out of the elements. The bird team also broadened the temperature protocols for the

lorikeets. Previously, the lorikeets were only allowed to have exhibit access if temperatures were above 45F, but were allowed to keep access to outside howdy cages at 40F. Since we were unconcerned about the birds' ability to shift inside, we lowered the exhibit temperature to match so that birds now could stay with access to exhibit down to 40F. This allowed for a higher number of days and nights that birds were allowed exhibit access. The lorikeet flock is still shifted inside each night and then given access when temperatures allow. This helps to keep them in practice of shifting and gives keepers a chance to get an eye on everyone. Watching the behavior of the flock, it was noticed that a lot of slower shifters were coming to individual shift doors, looking inside and then moving on to the next. The holding is set up with 7 enclosures, each with its own shift door to an outside howdy, which all lead to exhibit. All 7 enclosures and howdies have shift doors between as well, so can be separated off or given access. Historically, the doors between enclosures would be closed to create 7 individual enclosures while bringing birds inside. This meant that some of the birds would look at all their options before committing to an enclosure. Keepers began opening all of the between doors in both inside and howdy enclosures so birds could easily move around. These doors are only shut when needed for counting, medicating, etc. and reopened. This change has encouraged some of the more timid birds to shift inside much quicker and comfortably.

For some birds, feather plucking occurrences seem to coincide with nesting interest. Often, when wanting to breed certain individuals, those birds are separated from the flock into a nesting set up. Birds in the flock have ample opportunity to chew logs and dig in planters, but not much for actual nesting opportunities. Keepers were given a unique opportunity in the summer of 2020 (when the zoo was closed due to COVID-19) to put a large amount of nest boxes on exhibit without worry of how it would impact lorikeet feeding by guests. Seeing many of the birds claiming nest boxes that summer, keepers again put multiple boxes on exhibit in summer of 2021 with the exhibit open. It was found that for the most part, birds are still eating from guests and are actually sometimes easier to find. Keepers did have to monitor situations for a few birds that tended to be aggressive towards people while in a nest box. Having more boxes out allowed some of the less dominant birds to actually go through the nesting process. Undesirable pairs were allowed to sit dummies for the full term as well. A few of the feather problem birds improved while fulfilling these nesting opportunities.

The lorikeet diet has been adjusted in the last couple of years as well. While the nectar diet changed out of need (an old product was discontinued), the result was a nectar blend that is more nutritious for the birds. An Omega3 supplement was also added to improve overall feather condition. Most recently, the Veterinary and Nutrition teams have been trialing an addition of bee pollen as a protein source. They've also been working with the Horticulture department to create an inside foraging opportunity with sprouted seed flats and researching growing flowers that are a natural pollen source for Rainbow Lorikeets.

The Lorikeet Poor Feather Condition Plan has been a true team effort that is constantly leading to better care for the lorikeet flock. While feather plucking problems are complicated and not easily solved, keepers now notice behavioral, social, and physical changes within the flock much quicker. Also, a small group is working together to go over past data and look for trends within

the flock and for specific individuals with a cyclic history of feather plucking. This data will allow keepers to continue to modify the care of the lorikeets at Denver Zoo.

Rethinking Black-tailed Prairie Dog Care and Management

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Introduction

Diurnal rodents from the *Sciuridae* family, black-tailed prairie dogs (*Cynomys ludovicianus)* are a popular exhibit species at zoological institutions (Eltorai & Sussman, 2011). Prairie dogs are known to be highly intelligent (Cain & Carlson, 1975), demonstrate rapid social learning (Dobson et al., 1997; Shier & Owings, 2007), and possess a highly complex social system comparable to those of savannah primates (Slobodchikoff et al., 2009). Prairie dogs delight zoo patrons as they can be housed comfortably in high densities (Reynolds & Fox, 1977), will congregate near large groups of visitors (Eltorai & Sussman, 2010), and demonstrate a wide and engaging behavioral repertoire (Smith et al., 1973).

Black-tailed prairie dogs also have an important conservation story to share with zoo visitors. Their current range is fragmented and significantly reduced, they are threatened by disease, and persecuted as pests (Santymire & Graves, 2020), yet they are often referred to as a keystone species in the American grasslands (Hoogland, 2006). They have a substantial and unique impact on countless other species of plants, insects, amphibians, reptiles, birds, and mammals, and provide essential ecosystem services such as nutrient redistribution and enhanced vegetational productivity (Hoogland, 2006). Additionally, black-tailed prairie dogs serve as a critical food source for the endangered black-footed ferret (Belant et al., 2015). The U.S. Fish and Wildlife Service has been clear that the fate of black-footed ferrets and prairie dogs is linked. As stated in the Black-footed Ferret Recovery Plan, “the single, most feasible action that would benefit black-footed ferret recovery is to improve prairie dog conservation” (2013, p. 7). For these reasons, zoo-managed prairie dog colonies serve an integral role in inspiring visitors to protect North America’s prairie ecosystems.

Traditional Management

Despite their popularity, zoos housing black-tailed prairie dogs often report challenges in their care. Due to their relatively homogeneous appearance, individual animals are hard to distinguish from one another (Hogland, 1995). They also create complex burrow systems, causing many facilities to report an inability to get a positive count or visually examine each animal regularly (Hughes, 2019). It’s nearly impossible to access the animals once they have gone underground, which makes removing them from the exhibit very challenging. Stressful and time-consuming methods, such as live trapping, are sometimes used due to a lack of other options (Hoogland, 1995; Hughes, 2019; Smith et al., 1973). As a result, facilities report losing animals due to an inability to respond to time-sensitive medical or environmental concerns (Hughes, 2019).

Another common challenge in prairie dog care is social and reproductive management. Black-tailed prairie dog social structure fluctuates dramatically in an annual cycle (Smith et al., 1973). These shifts can occur rapidly and result in prolonged periods of intraspecific aggression (Thomas et al., 2019). Even in managed care, this aggression can escalate to injury or death,

particularly as individuals fight to establish breeding coteries (Smith et al, 1973). Lack of reproductive management options can also cause exhibits to range from sparsely populated to overcrowded at any given time (Hughes, 2019; Smith et al., 1973).

Due to the combination of these challenges, black-tailed prairie dogs are generally managed in a very hands-off manner, being provided with food and bedding by staff but otherwise left to their own devices. At some facilities, current prairie dogs are descendants of a single founding group released into the habitat decades prior, and caretakers may not even know how many prairie dogs they have (Hughes, 2019; Smith et al., 1973; Thomas et al., 2019).

Reports of management practices and challenges in housing black-tailed prairie dogs are strikingly similar between 1973 (Smith et al.) and 2019 (Hughes), indicating that husbandry practices for this species have largely remained static across five decades. Zoological institutions must consider the implications of this historic management style on the prairie dogs' individual welfare. Updated recommendations for prairie dog care are needed to prevent overpopulation of exhibits while maintaining the integrity of breeding colonies, curb aggression and social instability, allow for timely medical care, and to keep animals safe from hazardous exhibit maintenance, severe weather, and predators.

In the following section, I present a case study from the Frank Buck Zoo in which the prairie dog colony is managed not as a unit, but as a collection of individuals with discrete needs. Using a hands-on, proactive approach to colony management, typical challenges with managing prairie dogs are eliminated, resulting in elevated welfare for this species.

Case Study in Cooperative Management

In 2018 The Frank Buck Zoo had the opportunity to move its existing prairie dog colony into a new habitat. This habitat offered a greater degree of complexity in furnishings, substrates, and foliage than their previous enclosure (Image 1). Year-round the animals engage in a wide variety of species-specific behaviors such as burrowing, grazing, dust-bathing, scanning for predators, and socializing with conspecifics. Animal Care Staff have been thrilled to observe the prairie dogs displaying behaviors that had never been seen in their old exhibit, indicating a significant positive impact on their overall welfare.

Image 1: Black-tailed prairie dog exhibit at the Frank Buck Zoo.

The new habitat also encompasses a much larger footprint than the colony had previously, so the zoo can house more animals than before. The colony has been able to grow in size, enabling the prairie dogs to experience a more complex, naturalistic, multi-generational social structure as the species is known for.

Although this exhibit was not new to the zoo itself, it was retrofitted for the prairie dogs specifically to address the common challenges with traditional management. One significant feature is the existence of a nighthouse. After moving into the new habitat, staff trained the prairie dogs to shift on and off exhibit daily. Once the first few animals mastered the process, it wasn't long before the rest followed their lead and the entire colony was reliably shifting twice a day. Although an auditory cue was not initially used, a bell was later added to alert animals in the burrows when it is time to come inside, which improved the process considerably.

The ability to quickly and reliably shift the prairie dogs out of their exhibit ensures they can be kept safe during exhibit maintenance or periods of severe weather. Staff visually examine each animal at least twice a day and can respond immediately to any medical concerns or social changes within the group. With additional training, the colony has also grown comfortable entering a removable crate in the nighthouse so they can be entirely removed from the habitat quickly and with minimal stress (Image 2).

Image 2: A group of prairie dogs voluntarily crated in their nighthouse and now calmly wait for a medical procedure.

Seasonal Social and Reproductive Management

Seasonally, the prairie dog colony is split into multiple smaller stable social groups to prevent escalating aggression around the breeding season. When reproduction is not desired, animals are housed in two single-sex groups. One remains in the habitat and the other moves to an off-exhibit space. This method has been highly effective at mitigating seasonal social aggression.

The prairie dogs are bred every few years to maintain a stable population. Years when reproduction is desired, some animals are split into breeding groups and others into single-sex groups. Specifically selecting animals for the breeding groups helps minimize male-male

aggression, prevents inbreeding, allows staff to monitor pregnancy progression, know the exact birth dates and pedigree of all animals, and eliminates the possibility of infanticide by other females.

At the end of each breeding season, the prairie dogs are reintroduced into one cohesive colony on-exhibit using a howdy system (Image 3). As evidence of their intelligence and trainability, animals that have been out of the habitat for many months typically still immediately respond to the evening recall.

Image 3: A prairie dog in a howdy crate is greeted by two animals that are part of the exhibit colony.

Pup Training

Due to the staff's cooperative relationship with the prairie dogs, lactating females will voluntarily enter a crate and calmly look on as animal care staff handle and examine their offspring. Socialization begins when pups are just a few weeks old before their eyes have even opened (Image 4). Staff sex, handle, and weigh the pups to monitor their development. As they become mobile, they continue to be regularly handled, screened for parasites or other concerns, and eventually microchipped for future identification. By a few months of age, staff begins training the pups to perform behaviors including targeting, voluntary weight collection, and voluntary crating, which are important for their continued care as they reach maturity (Image 5). Ultimately, they are incorporated into the exhibit colony, but the impact of socialization from an early age is evident years later. Socialized adults remember many of the behaviors they practiced as pups, and can often be crated on-exhibit and handled by animal care staff with minimal stress.


Image 4 (left): At two weeks old, prairie dog pups begin to be handled by staff.
Image 5 (right): An adult female prairie dog who was trained for weight collection as a pup, recalls the behavior years later.

Contraceptive Trials

The Frank Buck Zoo was awarded the 2021 Rodent Insectivore Lagomorph TAG RodentPro® Conservation Grant, to test the effectiveness of Depo-Provera® (Medroxyprogesterone acetate injection) at preventing seasonal social aggression and reproduction in black-tailed prairie dogs (Image 6). This research is significant as the AZA Reproduction Management Center's Contraception Program has very little useful data for this species (M. McDonald, personal communication, August 12, 2020). Unfortunately, at the dosage and frequency tested during the 2022 breeding season, Depo-Provera® proved ineffective at preventing either seasonal aggression or reproduction in the prairie dogs (Image 7). However, this project serves as an important data set to inform future trials and management decisions.


Image 6 (left): An adult female prairie dog receives an intramuscular injection of Depo-Provera® as part of the study.
Image 7 (right): Five healthy pups were produced by one of the females treated with Depo-Provera®, indicating that the drug is not effective at the dosage tested.

Conclusion

The Frank Buck Zoo is committed to continue to research and test novel care methods for black-tailed prairie dogs to eliminate common challenges in housing this species. By placing individual animal welfare at the forefront, the prairie dogs benefit from close medical monitoring, responsible breeding practices, stable social dynamics, and safety from hazardous conditions. Although there was an initial time investment to establish these procedures, they have proven to be well worthwhile. Overall, the colony takes very little time to care for on a typical day, and time-sensitive issues can be resolved using efficient, practiced, and low-stress procedures in which the animals play a participating role.

Taking an active, individualized approach to managing colonial animals is viewed very favorably by permitting agencies. In addition, zoo visitors are delighted to learn that regardless of stature, all animals at the facility receive the same level of care, training, and attention to welfare. Caretakers working with black-tailed prairie dogs at other facilities are overwhelmingly interested in taking a more active role in managing this species but do not necessarily feel this would be prioritized at an institutional level (Hughes, 2019). By putting forth a template for what cooperative prairie dog care looks like at the Frank Buck Zoo, it will be easier for other facilities to implement their own changes. Given the countless benefits of a proactive, welfare-focused husbandry program, there is no good reason not to.

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